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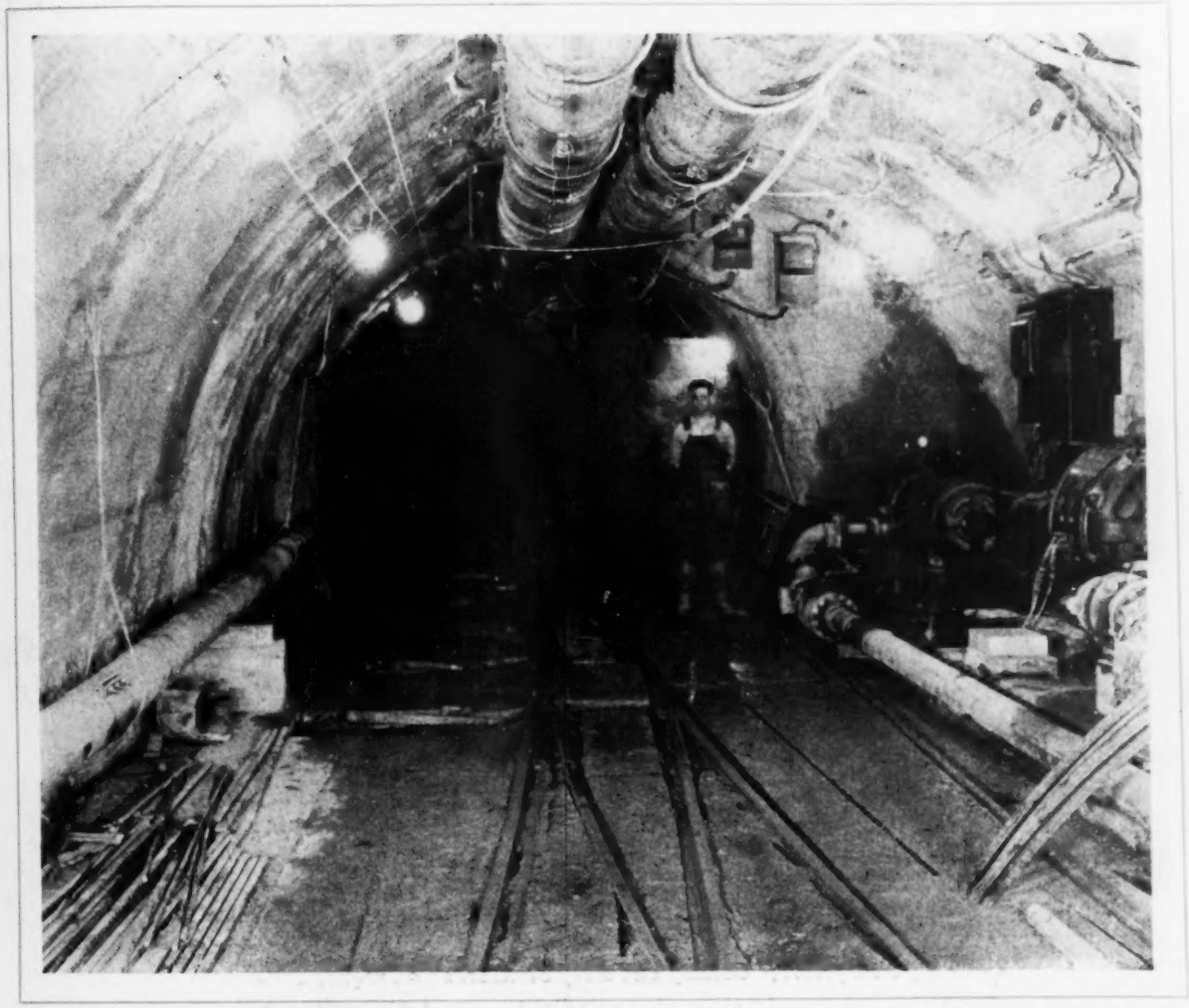

Pumping Station in Crosscut Hetch Hetchy Tunnel

Driving the Coast Range Tunnel, Hetch Hetchy Aqueduct
Multiple-Span Suspension Bridges
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Public Works Construction in Australia
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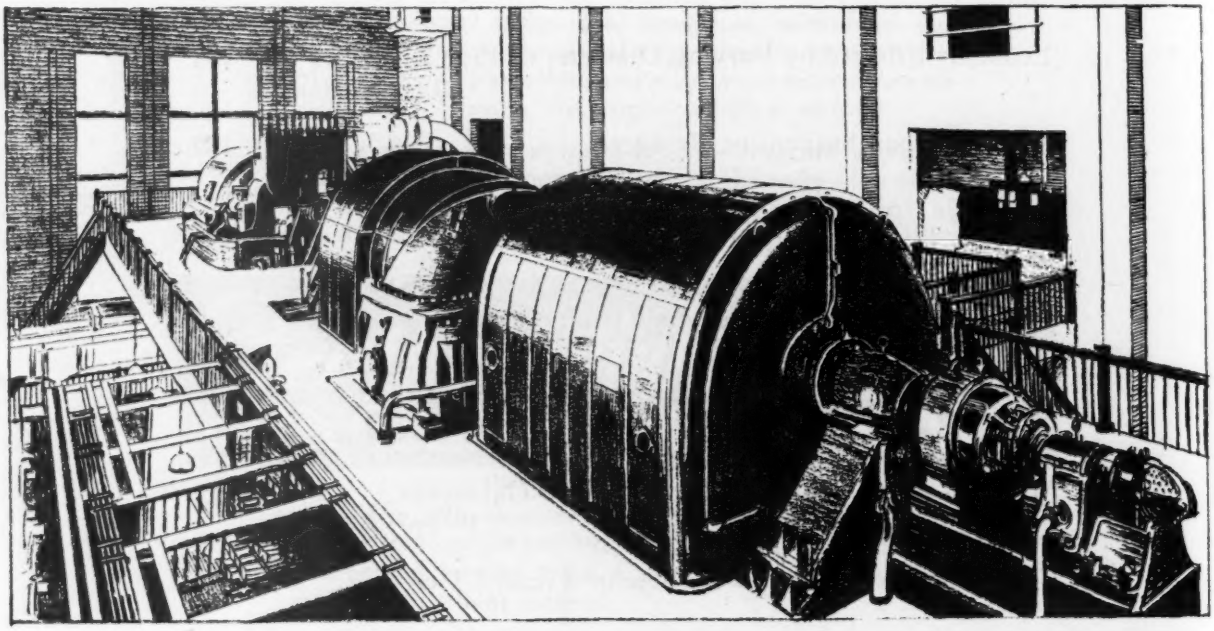

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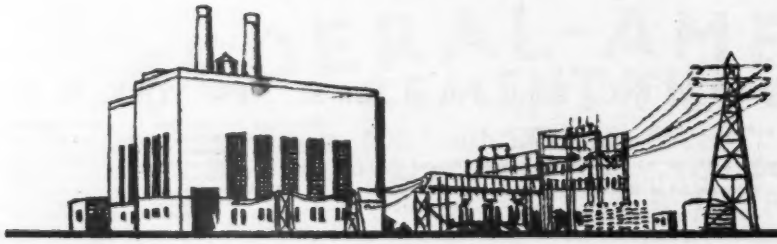

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. SCHMITT, *Editor*

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Irresponsible Owners

THE irresponsible contractor is a well-known figure in the construction world. Recognized as a menace to sound contracting, he is being opposed by legitimate contractors, wise engineers and understanding owners. His counterpart, the irresponsible owner, has had little or no attention whatever. This is the owner who asks contractors to bid on half-baked plans merely to get an estimate of the cost of proposed work, with no intention of awarding a contract. Less menacing than the irresponsible contractor, he yet injures the soundness of construction practice, by causing contractors much useless expense and trouble. Most often he is found among small-job owners, but occasionally among those who undertake large works, backed by supposedly reputable engineers. To call for bids with any intention other than that of awarding a contract is dishonest and unfair. Joint action by engineers and contractors could do much to end the evil. It would be a worth-while fight.

Living Off the Public

A BILL now before Congress makes the refreshing proposal that the national government set up the land owners on the Shoshone reclamation project in a profitable power business, by turning over to them as a gift a power plant that was built at the project's irrigation dam with public money. The purpose of the transfer is to permit them to use the profits of the power plant to pay for their canals; actually the plant income would do more than pay for the canals; it would yield the residents a profit to live on. There is to be no investment of money on the part of the local people and no assumption of risk. The bill represents a simple case of trying to divert public money into private pockets. Question may be raised whether the government should have built the plant at all, but this is not the matter now at issue. The plain challenge of the present case is whether public money is to be used for public purposes or for private benefit. The reclamation policy was established to loan settlers on arid land the means to build irrigation works, the loan to be repaid without interest. Shall it continue in this purpose or shall it be distorted into a general means of providing sources of profit to local interests?

Inequitable Taxation

ALL too often water consumers are saddled with an abnormally high rate which produces more money than the water service demands. It is apparently easier to utilize this rate as a device for levying funds to pay the salaries of city officials and the cost of police protection, street cleaning or health service than to levy taxes for these expenditures. The inequity comes in the fact that the water user pays taxes which the speculative holder of unimproved land evades unless there is a frontage rate collected from the bare land. A flagrant example of the abuse of the water utility just comes to notice. Colby, Kan., is boasting that no municipal taxes will be levied but that the water plant during the past two years has paid all administration bills, provided $200,000 for pavements and put a tidy balance in the city treasury. For years the Chicago water consumers did essentially the same thing. A small suburb of Chicago is today buying water from its neighbor at $45,000 and collecting $95,000 from its citizens. The ease with which a water utility may be sandbagged and still survive indicates how fully the consumer appreciates its importance; unless he did he would never tolerate such inequity.

Evidence of Irritation

EXCEPT in one point, but that a highly important one, there is not much real interest in the dispute that has arisen between the Senate and the President over the membership of the Federal Power Commission. The dispute itself is childish. No question can be raised as to the ability or integrity of the commissioners under attack—chiefly George Otis Smith, the long-time capable head of the Geological Survey, and Marcel Garsaud, well-known New Orleans engineer. The Senate approved the appointments and now wants to reconsider them because the commissioners notified their staff somewhat tactlessly that their service automatically terminated when the old commission went out of office, and because this abrupt dismissal seemed to reflect on two officials who had been particularly energetic in investigating power company finances. As the Senate's approval of presidential appointments is an obvious finality, the attempted reconsideration seems rather absurd. But it gives strong evidence of the fact that the Senate is touchy on power matters, which is important because it reflects a public state of mind, not merely that of a group of Senators. The prominence of the dispute, and indeed its very nature, will intensify the critical attitude of many citizens as well as of Congress itself toward power utilities. Our suggestion shortly after the election, that it is an excellent time for utility men themselves to unite on sound utility policy and back it up with constructive public relations, is even more pertinent in view of the new developments and their natural effects.

House and Home

EVERYONE is conscious of the fact that a progressive increase in residential renting has been going on for years, with a corresponding decrease in home

ownership. Many think this trend is altogether wrong and perverse. They see in the renting habit not only a bad influence in general but also a contributory cause of the sharp decrease in house-building that marked the last two years. This is why home ownership is advocated rather insistently, and why a government committee to promote house building has the words "home ownership" incorporated in its title. Yet the actual growth of the world is each year making the population more mobile, just as money and enterprise become more mobile. This change is quite inevitable and necessary in view of the steady increase in use of transportation. Can we then reasonably hope that the majority of the people will be willing to fix themselves in one locality by home ownership? And must it be assumed that the dormant business of residential construction cannot be revived unless the percentage of home owners is increased? These are questions worth thinking about. There can be both house and home without ownership, and the difficulties that make house-building costly and unsatisfactory have no apparent relation to the difference between owning and renting. It is desirable that there should be more house-building, and proper to study ways and means of promoting it, but the movement should not have to carry the useless ballast of a false ideal.

Something New in Bridges

NEW possibilities for suspension bridge design are contained in the proposal to develop multiple-span structures, as set forth in an article in this issue. Several prominent bridge engineers have recently made studies of such bridges in the course of determining the best type of structure for a particular crossing, so that the proposal has the background of present-day reality. The idea of a bridge made up of a series of suspended spans is not strictly new, a five-span structure having been completed in 1839 over the Dordogne River near Cubzac in France. Fortune de Vergez, the engineer of this pioneer structure, used inclined tie cables running from the top of the tower at one end of a span to a roadway-level connection on the opposite tower, but the principle was the same as in the present proposal, which uses horizontal tie cables between the tower tops to control and limit the tower deflection from unbalanced loads. The Cubzac bridge had few if any counterparts, so that multiple-span construction of suspension bridges has not been among the accomplishments of the modern engineer. It is well that the idea has been resurrected. There are many locations where a series of suspended spans might provide an ideal bridge. For a long crossing, the total cost of small anchorages and a number of piers might be less than the cost of the huge anchorages for a single span. At another location, the uniform and small pier reactions of a multiple-span suspension bridge might prove an advantage over the much larger pier reaction under the main tower of a cantilever bridge. Numerous other possibilities could be enumerated. Theoretically, multiple-span suspension bridges with tie cables are perfectly feasible. Whether they would bear economic comparison with other types of bridges would largely seem to depend upon erection costs and difficulties. But in regard to the latter, many recent erection achievements indicate that the art is able to cope with almost anything that the engineer can design. It is therefore timely that engineers take note of the possibilities of the multiple-span suspension bridge.

Breadth and Professional Unity

AS THE profession of civil engineering is evolving with the steady extension of its scope of activity, a sharp conflict between breadth and specialization becomes apparent. It is significant for both the profession as a whole and its individual members. The outlook is that this conflict will play a major part in professional affairs for a long time to come. It leads to a central question of great importance. Will the profession maintain its unity and cohesion, or will it again divide into small groups as it did a half century ago?

The conflict originated in the increase in number of separate functions of the civil engineer through crystallization of minor or incidental activities into independent fields. Simultaneously each of the profession's branches, old and new, grew to larger size and complexity, compelling intensive specialization. These trends still continue strongly. Their effect is twofold: first, to withdraw the individual's interest and attention from branches other than his own, thus narrowing his knowledge and ability and confining the range of his work; second, to cause the groups of men interested in the separate branches to draw away from each other progressively, and to form societies or society divisions substantially independent in interest. By reason of this second effect, the broadening educational stimulus which the engineer formerly experienced in his society attendance and contacts has largely disappeared.

As this dual narrowing went on, the engineer's working conditions changed in the direction of making breadth of skill and knowledge a more important consideration. Enterprises of planning and construction today tend to be not only larger but also more comprehensive in character than formerly. Even where their technical elements are of a single kind, calling for the resources of only a single specialty, economic and other factors which control the engineering solution usually extend out into fields well beyond. Volume of work, amount of money involved, value of construction time, and interlocking of the enterprise with adjacent or affected interests have all grown into new dimensions, which require of the directing engineer a broad capacity to appraise facts and form judgments, far greater than in the pre-war era.

To take a specific example: In water-power development, a field which always called for a wide and varied range of knowledge, specialization has changed matters rather markedly. Hydrology today is a subject of such detail that only a specialist is fully at home in it; and hydrological data are a necessary starting point for the power project. But the hydrologist is equipped only for subsidiary service. The engineer capable of directing the entire project must couple the hydrology with extensive knowledge of streamflow and stream behavior, with competence in the intricate problems of dam selection and design, with a fair amount of geological perception, with knowledge of power production and transmission, large valves and waste-discharge phenomena, and, by no means least, with ability in power market studies and administrative phases of sale and distribution of power. It is likely that road and railway relocations incidental to his project may necessitate his having apt judgment of traffic values, present and prospective, and if the claims of contiguous interests need to be verified he may find it necessary to conduct traffic surveys—themselves recently erected into an independent specialty. Throughout he may have to frame his reasoning in terms of fifty or a hundred million

dollars as familiarly as formerly in terms of a million or two. Obviously, the narrow technician, devoted to deep study of a limited branch of civil engineering, is in these operations useful only for staff service but not for sharing the responsibility of general planning and direction of the work.

There is continuing movement toward more intensive specialization of the individual and also toward greater scope of the problems of practice. Hence the disparity between demand and capacity, the conflict between breadth and specialization, will grow. We set forth this noteworthy fact because we believe that it carries much meaning for the individual and also for the schools and societies from which he derives an important part of his technical education.

For the individual it means, in our judgment, a well-proportioned harmonizing of the two conflicting demands. We grant that he must specialize; superficial knowledge even of many fields will not make him useful as an engineer. Yet in addition to mastering his specialty he can at the same time develop a general knowledge of related engineering branches and also of economics and business relations by which he will command breadth of judgment having remarkable practical value. This, as we see it, is the necessary course of growth of the present-day and future engineer—the acquisition of a very considerable breadth, superimposed on effective special knowledge.

Of the agencies which help to shape the progress of the civil engineer's knowledge—the college and the society—the college has already felt the influence of the new conditions. It has for some time been involved in a battle between the opposing claims of breadth and specialization, with the former slowly gaining the upper hand. This is of primary importance, for unless the breadth of civil engineering understanding is supported and maintained the profession is little likely to resist the disintegrating tendencies at work. It will break up into bits, united at best by a meaningless name.

Society developments have in this regard been quite static. It may be questioned whether many technical societies recognize the increasing importance of breadth, for in most of them the movement is strongly toward greater specialization and differentiation. Yet if we appraise the demand of the times correctly, the effective service of the modern technical society lies in even-handed consideration of specialized and broad matters. Possibly the major responsibility in this direction devolves upon local and regional organizations; the national associations are turning more and more to the conduct of gatherings of the congress type, or assemblages of mainly social value. Technical sessions and discussions are finding their truly congenial home in local meetings. But detail aside, it is fair to set down as the ideal of technical society service that it should encourage the bonding together of its discrete professional elements by discussions of great breadth and effective interchange of view between men of widely separate fields; and that as a secondary service it should cultivate intensity of study in its component fields through papers and discussions of deep specialization.

How far society functioning can be adapted to this ideal is not at present assured. The momentary trend is toward specialization of a kind that may ultimately mean disintegration. While the profession still remains an entity, walls are building up between the separate units in society activities. Within the societies, internal efforts at guidance all seem to favor the progress of this fission and encystment. Outside forces are active both to separate and to draw together. Some of these forces have lines of action that cut across established professional boundaries, and, for example, draw together mechanical and civil engineers in various joint interests, such as matters having to do with materials or transport.

The ultimate grouping of professional units therefore is not readily foreseen. But the present is still a time which makes a clamorous demand for civil engineering unity. Those who direct technical college activities have begun to recognize this fact, and in our belief they will progress rather rapidly toward the objective of educating civil engineers rather than branch specialists. No similar trend has yet established itself in the society field. Hence the time is at hand for an aggressive study of the situation and a reorganization of society activities that will tend toward unity and breadth, and thus help to maintain and strengthen the profession's integrity.

Federal Control Questioned

OF OUTSTANDING importance in the report of the St. Lawrence Power Development Commission to the New York state legislature is the opinion expressed by the commission's legal advisers upon the constitutionality of the federal water-power act. So far as that act is directed toward the regulation and control of power projects in relation to navigation, the legal advisers say, it is within the constitutional power of the United States government; but they believe that the act is not directed to regulating navigation but represents an assertion of authority over power projects as such, beyond their relation to navigation. Such assertion of authority, they hold, is unconstitutional and beyond the powers of the United States government. Hence, they believe, the federal water-power act is invalid.

This is the second serious attack upon the authority of the Federal Power Commission in recent months. Last summer the attorney general put an effective check upon any extension of the Federal Power Commission's authority to include the financing of water-power plants upon the non-navigable sections of navigable rivers. Carried to its logical conclusion, that ruling denies the commission's powers over the financing of any power plant, as was pointed out in more detail in these columns at that time. Now the legal advisers of the State of New York attack the act upon similar grounds.

These legal authorities do not recommend a test of the constitutionality of the act now, because of the time element involved. They believe that the state may apply for a license to develop power on the St. Lawrence River without prejudice to its existing rights. Nevertheless it is apparent that a test of the constitutionality of the act is sure to come. The act cannot now be made fully effective until this question is settled. The test should be made soon, because questions of power rates and the control of interstate transmission of power are daily becoming more and more important. They are so closely tied in to the federal water-power act that the status of the act should not be left long hanging in the balance. If the broad powers over financing which the act gives to the commission are unconstitutional, then that fact should be established definitely so that Congress or the individual states can act accordingly when considering power development.

Hetch Hetchy Tunnel Construction

San Francisco's new aqueduct nearly half way through last mountain barrier of 28½ miles—Construction notable for good organization and method developed for holding squeezing ground by sub-lining of gunite

ADVANCING from fourteen headings, tunnel driving is about 40 per cent completed on the 28½-mile bore through the Coast Range which is the last mountain barrier to be pierced before water from the Hetch Hetchy supply can be delivered in San Francisco. When the present work is nearer completion the 47 miles of pipe line will be laid across the San Joaquin Valley to connect the east portal of this tunnel with the western end of the Foothill Division tunnels; this will finish the aqueduct line (Fig. 1). Construction work on this notable water-supply project has been described from time to time in *Engineering News-Record;* the last two articles outlining progress appeared April 19, 1928, p. 614, and Jan. 31, 1929, p. 171.

The Coast Range tunnel will have inside diameter of 10½ ft., and a capacity of 300 m.g.d., which will supply the city adequately for many years. The ultimate plan proposes a similar parallel bore 175 ft. south of the present tunnel when an increased supply is necessary. This twin-tunnel plan was adopted to save the additional investment and carrying charges for a tunnel large enough to deliver the estimated ultimate supply of 450 m.g.d.

Construction Difficulties Met

The formation penetrated is sedimentary and the tunnel is timbered almost continuously. As had been expected, some rather extensive sections of heavy ground have been encountered which necessitated uneconomically heavy timbering and timber replacement. These conditions were met by the unusual expedient of a gunite sub-lining from 18 to 24 in. thick. The success of this method resulted in its increased use until more than 8,000 cu.yd. of gunite lining had been placed up to May 1, 1930.

All work on the Coast Range tunnel is by the construction forces of the city and it is reported that under the existing conditions this will result in material economy. The character of the ground is uncertain and subject to wide variation, which would make it necessary for a contractor to protect himself with a price based on the anticipation of unfavorable conditions. The city secures the advantage over the large percentage of the distance where conditions are favorable. A large and efficient tunneling organization has been built up through past years of tunnel work on the upper divisions of the aqueduct. Many of the construction engineers have been building tunnel for years and many of the superintendents have been trained and promoted from shift bosses. Large amounts of tunneling equipment were on hand.

Plant Installation and Shaft Sinking

The alignment and profile of the Coast Range tunnels are shown by Fig. 2. The total distance through the range on the aqueduct line is 29.1 miles, which is all tunnel with the exception of a 0.6-mile siphon across Alameda Creek. Slight variations from a straight alignment permit the economical use of five shafts from 5.22 miles to 2.9 miles apart. Work is under way from the ten shaft headings and the four portals. The progress made to May 1 is shown in Fig. 2.

The town of Livermore, served by two railroads, was selected as a convenient location for headquarters and shops. About 50 miles of roads were built or reconstructed to reach the shafts and portals. A 6,000-kva. main substation was located at a central point on the city's 110-kv. transmission line and a 23,000-volt line for construction purposes was built over the tunnel line the en-

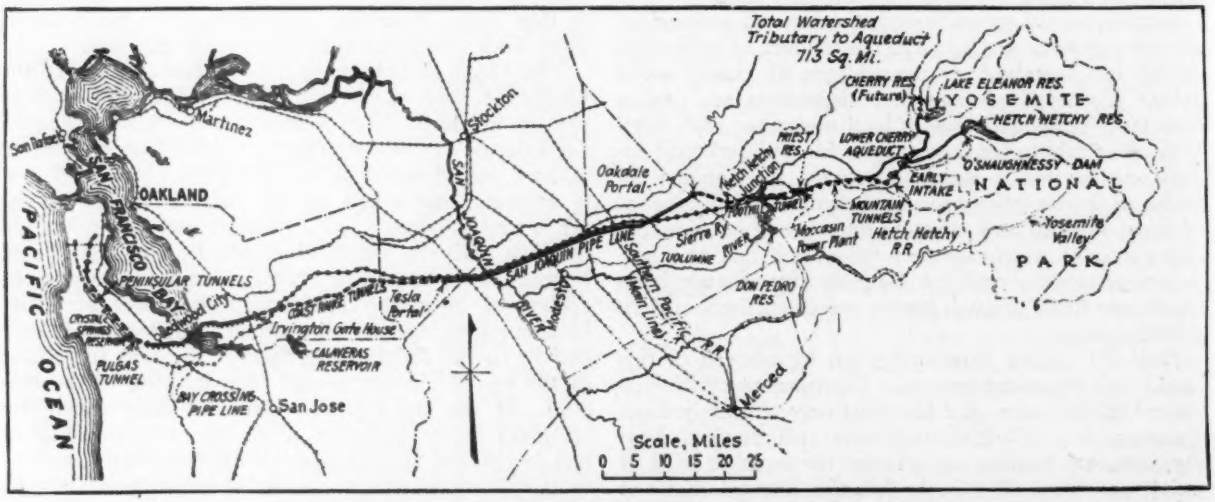

Fig. 1—General map of Hetch Hetchy project, showing present development

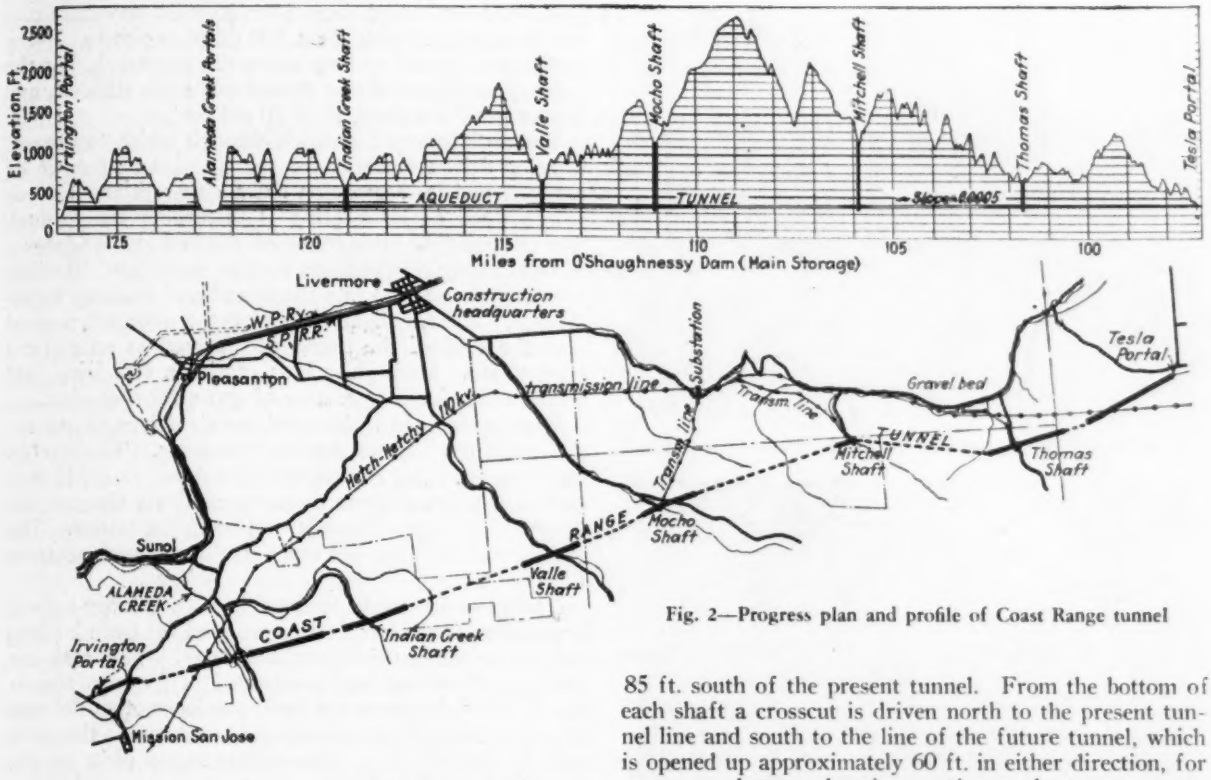

Fig. 2—Progress plan and profile of Coast Range tunnel

tire distance between portals, with a substation at each camp. Extensive shops were built at the Livermore headquarters and a large storage yard was established for materials and equipment moved down from the upper divisions or newly purchased. A telephone system connects headquarters with each of the camps.

The camps at the various shafts and portals consist of five-man bunk houses, dining room, office and shops. The portal camps have crews of between 60 and 85 men and the shaft camps have crews of from 130 to 180 men. Dry, warm summers make water supply for the camps a major problem. Wells, water piped 4 to 5 miles from springs and at one shaft a filtration plant to treat tunnel water for all but drinking purposes are some of the means of meeting this difficulty.

All major equipment at the camps is electrically driven with power taken from the 23,000-volt line. The typical compressor installation for each heading is two 675-ft. compressors driven by 100-hp. motors. The ventilating blowers vary from 5,000-cu.ft. machines for 1-lb. pressure, which had been used previously on the upper division, to new 10,000-cu.ft. blowers to operate at 4-lb. maximum pressure with 200-hp. motors. Electrically operated 150-hp. hoists are typical installations for the handling of material at the shafts.

Shaft Sinking—The shafts vary in depth from 818 ft. at Mocho (Fig. 2) to 305 ft. at Indian Creek; they are 7 ft. 1 in. by 20 ft. 4 in., measured on the outside of standard 8x8-in. timber sets and 2-in. lagging. When heavier timbering was required, the outside dimensions were increased accordingly. Two compartments are provided for counterbalanced skips; the remaining space forms a manway which also contains the pipe lines. The design and arrangement of the shafts were governed by the fact that they are permanent and will be used again when the second tunnel is driven. They are located midway between the present and second tunnel lines, or about 85 ft. south of the present tunnel. From the bottom of each shaft a crosscut is driven north to the present tunnel line and south to the line of the future tunnel, which is opened up approximately 60 ft. in either direction, for use as a battery-charging station and storage space. All the shafts have permanent concrete lining, including rock pockets and sumps. In addition, the station at tunnel level and the crosscuts are concrete lined as part of the preliminary work.

Shaft sinking presented varying problems, including hydrogen sulphide gas, water-bearing seams which necessitated grouting, and swelling ground that required heavy timbering. In the more favorable locations sandstone was encountered with only moderate amounts of water and, although timbering was usually required during sinking, the permanent concrete lining was completed without serious difficulty.

Work at Mitchell shaft (804 ft. deep) was delayed at the outset by legal problems in securing access to the camp location, followed by unusually difficult physical conditions encountered during sinking. These delays account for the short distances advanced by the two headings from this shaft as indicated by Fig. 2. The longest section to be driven is west from this shaft to

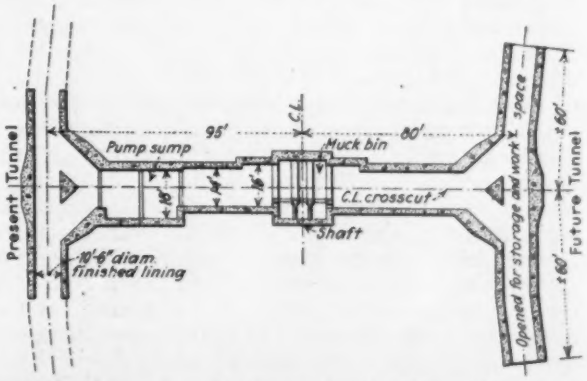

Fig. 3—Crosscuts to the future tunnel provide working space at the foot of the shafts

Fig. 4—Pumping stations are located in the crosscuts

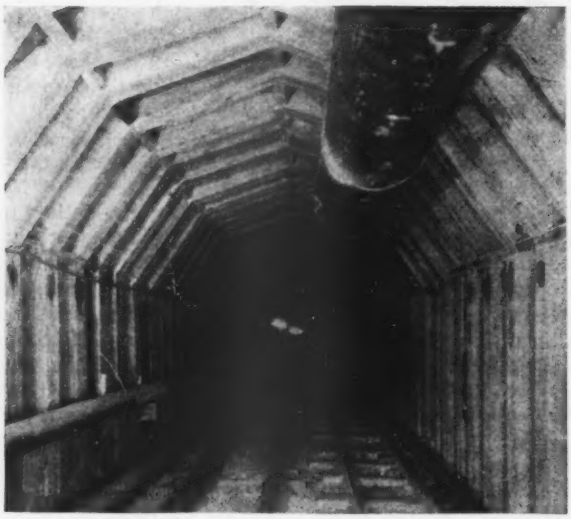

Fig. 5—Standard timbering in good ground
Both four- and six-segment arches are used. The location of the services shown here is typical of the standard sections.

meet the east heading from Mocho (818 ft. deep), a distance of 5.22 miles, and it probably will be the last to be holed through.

Tunnel Driving Plant and Methods

Methods of work at the various headings are as numerous as the formations encountered. These vary from soft clay, which may have gravel embedded in it, to shale, compressed sand, soft sandstone, which is often in large blocks, and a few strata of schist of varying degrees of hardness. The formation often changes within short distances, with the result that each camp experiences most of the range in tunneling conditions. As one extreme, at the Tesla portal almost one mile was excavated through clay by air spades. Slightly harder material which cannot be spaded is drilled for shooting with air-driven augers. For the harder formations in sandstone and schist it is the general practice to use jackhammers or Leyner drills. In the material requiring drilling the general plan is to pull a round of about 6 to 7 ft. No typical arrangement of holes can be outlined, as the rounds are constantly varied to meet the conditions encountered. In the softer material, where the jackhammers are used, a round may consist of 28 to 30 holes loaded with from 50 to 75 lb. of 40 per cent dynamite. In the harder ground, where two Leyner drills on a horizontal bar is used, from 34 to 36 holes may constitute the round loaded with about 100 lb. of explosive. Every precaution is used to keep down the overbreak, but the varying conditions of the ground make this difficult, and it averages from about 15 to 20 per cent.

The sedimentary formation through which the tunnel is being driven accounts for the occasional presence of methane and its companion gases either at the face or where work of retimbering is disturbing the ground. The uncertainty of this condition resulted in the adoption of rigid safety requirements for the entire job. Matches are not to be carried into the tunnel and smoking is not allowed. Electric light globes at the face when used near the roof of the tunnel are incased in an airtight glass guard. Each shift boss carries a test lamp and makes a test for the presence of gas after each shot.

Mucking is done with electric or air driven machines; this operation follows standard practices. The electric machines are being converted to air drive, as it becomes necessary to recondition them, to eliminate the possible danger of sparking if gas is present in the tunnel. The general plan calls for one extra machine at each camp as a spare.

Haulage—All inside haulage is with storage-battery locomotives; 5-ton locomotives are used for main haulage and 4-ton for gathering at the faces. The cars are 2-cu.yd., side-dump, and are hauled in four- to six-car trains. Arriving near the face, the locomotive delivers the string of empties on a siding and returns to the shaft with the loaded train. The smaller motor picks up the train and takes it to the face.

Loaded trains arriving at the shaft are dumped into rock pockets below the tunnel level and from there are loaded into 2-cu.yd. skips which may be operated in counterbalance. At the surface the muck is discharged into bins on the headframe and later is distributed on the dumps by cars drawn by a gasoline locomotive. At the portals the storage battery locomotive takes the trains directly to the dump or delivers them to gasoline locomotives, depending on the length of haul to the dump. The batteries of the underground locomotives are recharged at a station located in the stub end excavated for the future tunnel.

Ventilation and drainage—Ventilation at the face is provided by blowers located at the top of the shaft or portal and forcing air through 24-in. metal pipe suspended from the timbering. This pipe terminates about 50 ft. from the face and is extended as required. Fresh air is blown in through this pipe at all times except for a period of from about five minutes before a shot to about fifteen minutes afterward, when the pipe is used for suction.

Compressed air to operate the pumps, drills and mucking machines is supplied through a 4-in. pipe to the face. To provide a reserve for the peak loads on the mucking machines air receivers are placed in the line near the face.

Water, which is encountered in practically every heading, while not great in quantity, renders the work of excavation and track maintenance very difficult in the softer strata. The 0.005 grade in the tunnel is not sufficient to drain the water in the heading being driven upgrade. The local flow is ditched to sumps at convenient intervals along the track and lifted by small air-driven piston pumps into a 6-in. pipe line, which discharges into the main sump at the foot of the shaft. From the main sump the water is lifted to the surface by electric triplex or centrifugal pumps. The pumping equipment at all shafts is sufficient to care for a flow of

1,000 g.p.m.; although this amount has been reached occasionally, the average is considerably less and most of the shafts have a flow of only about 250 g.p.m.

Grouting is required occasionally to control excessive flow of water in several of the sections. Where conditions indicate the possible presence of water in quantity, pilot drill holes 15 to 30 ft. deep are carried forward ahead of the face. Grouting pressures of 400 lb. have been found sufficient, although the equipment will provide 600-lb. pressure if necessary. The primary reason for grouting is to eliminate water from the tunnel and improve working conditions, but in addition, it has probably helped prevent the drying up of several springs on ranches located over the tunnel line.

Timbering Methods—Driving was started using a standard set of 8x8-in. timbers on 5-ft. centers with a four-segment arch. For considerable distances even this support was not required, but in most cases it was carried forward to prevent spalling and to provide for the possibility of entering heavy ground unexpectedly. At some headings strata were encountered where this set did not prove sufficient and the development of adequate timbering became a major problem.

The size of timbers used in such heavy ground was increased to 12x12 in. and 12x16 in., and in a few cases 16x24-in. sets were resorted to in an effort to hold the squeeze. Different types of timbering sets were experimented with. The horseshoe-shaped set, with its advantage of reduced yardage for the concrete lining in the circular tunnel section, was tried but proved unsatisfactory in holding lateral movement of the ground near the floor and in addition restricted the bottom width so that sidings were impossible. Circular timber sets were tried and in one instance proved a satisfactory solution for holding wet, heavy clay, with the use of 4-in. lagging underneath the floor to keep the set from sinking or the floor from rising. As a general rule, however, the circular set with its horizontal timber underneath the tracks was unsatisfactory because of the added work and interruption caused when this timber broke or crushed and had to be replaced.

The standard four-segment arch set used at first was later changed to a six-segment arch for two reasons: (1) The closer conformity to a circle seemed to resist the pressures better; (2) it was possible to salvage many of the timbers from the four-segment sets which had been crushed at the ends, and cut them to six-segment size. At present the standard set (in so far as there is a standard) consists of the two vertical legs and a six-segment arch using timber from 8x8- to 12x16-in.

A few short sections of exceptionally heavy ground required an uneconomical amount of maintenance. The heaving bottom necessitated frequent work on reconditioning the tracks. Replacement of the timbering a second and even a third time often was required, with the resulting interference to muck trains. Increasing the size of timbers provided only temporary relief. Pressures always increased so slowly that the problem did not involve safety as much as the elimination of recurrent maintenance. In these sections it became essential to develop a lining of sufficient strength to eliminate further maintenance and one which could be placed with a minimum of interference to the other operations.

Provision had not been completed at this time for placing the permanent concrete lining. These preparations would have required the development of gravel pits and the erection of several complete concreting plants months before the main lining operations could be started. In addition, in this size of tunnel the pouring of a concrete lining would interfere greatly with the work of driving. Since progress is of first importance, it was desirable to maintain the sections already driven with the least possible interference with the work at the headings.

The possibility of a gunite lining in the sections where squeezing and movement were giving the most trouble offered the advantage of a small amount of equipment combined with extreme portability and minimum interference with driving. The portability was important, since short sections could be concreted where the need was most urgent. The equipment consisted of a concrete mixer at the top of the shaft to dry mix cement and sand from a temporary washing plant. The volume of guniting to be done made it economical to run the material through a mixer. This dry mix was dumped down the shaft through a pipe and loaded into 2-yd. cars. Hauled to the point of use it was shoveled into the usual type of guniting machine.

Preparation for placing the gunite lining was made by removing the timbers from a section of about 10 ft. long and placing a form board to provide a maximum gunite thickness of about 24 in. Where the surface of the rock was at a proper distance no back form was used. An inner guide for this circular lining consists of a cylindrical cage of reinforcing bars. The circular bars of

Fig. 6—Air spades were used extensively for excavating in soft ground

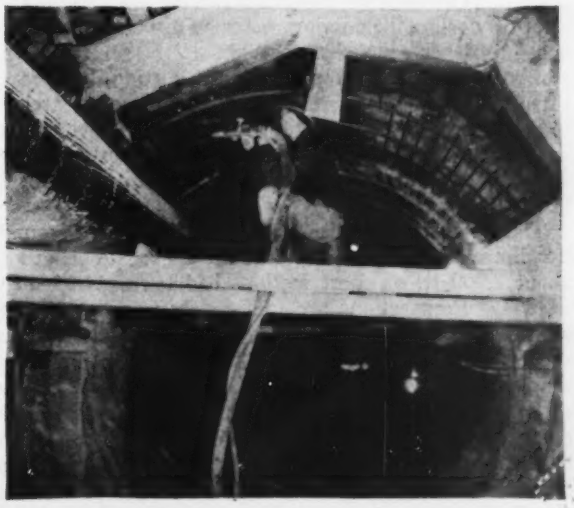

Fig. 7—Method of placing gunite lining

this cage are ¾ in. square, bent accurately in the shop to provide a diameter 3 in. greater than the finished tunnel lining to leave room for a subsequent 1½-in. finishing coat to give proper smoothness. The longitudinal bars are ⅜ in., spaced 4 in. apart around the hoops, which are spaced about 18 in. apart.

This cage is intended merely to provide a shooting guide for the inner surface of the gunite and to keep it from slumping down on the sides; its strength as reinforcing is not taken into consideration in the design of the lining. With the back form provided, the steel cage set in place and the track carried on stringers over the section to be gunited, preparations are completed for placing the lining. The cage is shown in Fig. 7. Starting at the bottom under the track, the gunite is carried up

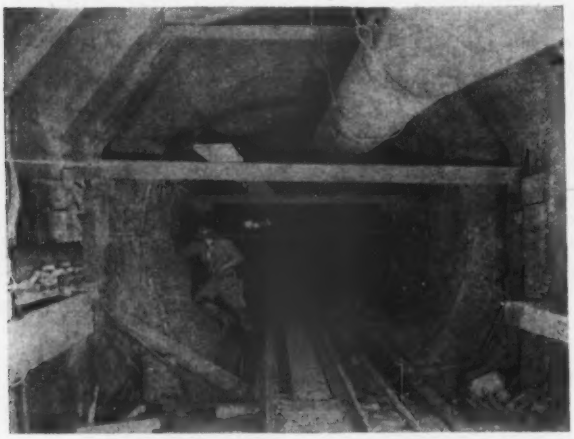

Fig. 8—Deflection measurements were taken in studies of rock pressures to be resisted

by an operator, who alternates from one side to the other to allow the material a little time to stiffen. The process is carried on continuously and is completed at the top to form a circular ring of gunite about 18 to 24 in. thick.

Because of the possibility of ground movement within a short time after the removal of the timbers it was necessary that the gunite should acquire high early strength. A high-alumina cement was first tried, but the thickness of the gunite resulted in excessive heating, which so seriously impaired the strength that a change was required. The present provision for early strength consists of dosing the mixing water with calcium chloride equal to 3 per cent of the weight of the cement. This admixture, although producing some heating, has proved satisfactory. Its use results in securing some strength in a few hours and about 60 per cent of 28-day strength in four days. The proportions of the gunite are ten sacks of cement per cubic yard of dry mix. This mix tests about 6,000 lb. in 28 days.

This type of lining requires about 3 cu.yd. of gunite per linear foot of tunnel, and an aggregate length of about 2,900 ft. of short sections had been placed up to May 1. Preparations are under way to carry on this work on a more extensive scale should it become necessary as the headings advance. In addition to the tunnel lining, several of the stations and crosscuts were lined with gunite; in one instance this lining material was placed to a maximum thickness of 4 ft. The method has proved highly successful, with no trouble developing even in the heaviest ground after the gunite was placed.

Studies are now under way to determine the design for the concrete lining. The preliminary design calls for a minimum thickness of 6 in. inside the timber line and for the removal of the timbers before concreting wherever possible. The amount of reinforcing necessary in the lining will depend upon the determination of the pressures found in the tunnel before the work of lining is undertaken. In some cases deflection tests have been made on timbers which have been removed, to measure the pressures they were sustaining when in place. More extensive tests are under way in the gunite-lined sections. Steel plugs were inserted in test sections of the lining for accurate determination of deformation. Check measurements are made at regular intervals and pressures are calculated from measured deformation after taking into consideration such factors as modulus of elasticity, shrinkage and flow under sustained load. These factors are being estimated from tests which are still in progress and not yet carried far enough to warrant description or statement of definite figures. Fig. 8 shows the method of making deflection measurements and the general appearance of a gunite section.

Organization

The work is under the general direction of M. M. O'Shaughnessy, city engineer of San Francisco, with L. T. McAfee as chief assistant. L. W. Stocker is in charge of water-supply engineering. Construction in the field is under the supervision of C. R. Rankin.

Since preparation of the foregoing article, several changes in equipment and operating procedure have been instituted on the project as additional safety precautions, resulting in large measure from the serious natural gas explosion in the east heading from the Mitchell shaft, reported in *Engineering News-Record*, July 24, 1930, p. 149. Following the explosion, work was practically suspended in the gaseous headings (*Engineering News-Record*, July 31, 1930, p. 189) for several months while the safety equipment could be installed, but progress on the tunnel now is averaging about 150 ft. per day, which almost equals the previous rate. On Nov. 18 a total of 80,540 ft. had been driven, which is about 55 per cent of the total tunnel length of 150,557 ft., and the most nearly completed section between Tesla portal and Thomas shaft was within half a mile of holing through. The use of gunite lining for sections of particularly heavy ground has been continued and an aggregate length of about 7,500 ft. has been placed.

The principal change in equipment was the installation of 27 permissive-type storage battery locomotives (4- and 5-ton size) for all hauling in the gaseous headings. Also, the work of converting the mucking machines from electric to air drive, as mentioned in the article, was completed. As a further safety measure, use of the electric lighting circuit has been discontinued in many of the headings and illumination by permissive storage-battery cap lamps substituted. This type of lighting naturally results in decreased working efficiency and speed in these headings.

Atmospheric conditions in the headings are checked continuously by electrical gas detectors. Ventilation in the gassy headings has been changed from the pressure system, as described, to the exhaust system, and blasting is not permitted until after all men have left the tunnel. It is estimated that the delay resulting from these changes will amount to about six months and as a result the tunnel will not be ready until the latter half of 1933.

Determination of Pipe Diameters for Maximum Economy

By C. W. HARRIS
Professor of Hydraulic Engineering
University of Washington

DETERMINATION of economic sizes of pipe for long pipe-line construction generally has been treated as a specific problem in which the results obtained will be dependent upon conditions peculiar to each length of pipe studied. In the discussion of the subject presented herewith Prof. C. W. Harris demonstrates that the chief factors involved in economic studies are independent of local conditions. —EDITOR.

THE question of economical diameter of a pipe line has been given frequent and careful study by many engineers. Most articles, however, treat the subject from the standpoint of special cases and thereby give the impression that the purpose of the pipe is a factor in determining relative diameters at various points along its profile. In these special treatments it is customary to make use of factors such as unit cost of material and cost of power in case of pumping plants or margin of profit in case of power projects. The unit cost of material and power is non-essential except for assigning of total friction head, and in some cases for fixing an average diameter. The distribution of diameters throughout the length of the pipe line, as fixed by the variable head, is independent of any such consideration.

The well-known Adams principle leads eventually to the conclusion that any pipe installed with a constant factor of safety throughout an irregular profile should be smaller at the points subjected to the greater pressure. From this and other simple relationships it has frequently been shown that the diameter of high-pressure steel pipe should vary from point to point in such manner as to remain inversely proportional to the seventh root of the pressure head for which the pipe is designed.

The application of this principle to the general case was set forth by the writer in a paper before the Pacific Northwest Society of Engineers, printed in July, 1913, in the *Proceedings* of the society, as follows:

"If the quantity to be delivered is fixed, and the available friction loss is also fixed, as is the case with a pipe line connecting two reservoirs of fixed elevations, the diameter of the pipe should vary throughout the length by the same laws expressed above, the head to which the pipe is subjected being the static head for which the pipe is designed."

But since specific cases have so frequently been considered necessary to the method of reaching this conclusion, the writer wishes to stress the point again that no study need be made concerning the purpose of the pipe line, except that it be for conducting water under pressure from one point to another. It may be a gravity main for a city water supply, or it may be a penstock for hydro-electric power purposes, or a pressure main for a pumping system. The relative diameters to be used for various pressure heads should in all cases be the same. In other words, for any given loss of head the pipe diameter can be increased at points of lower pressure and decreased at points of high pressure to result in the most economical proportions, provided these changes in diameter observe the proper relation to head.

For the purpose of bringing the statement of the problem promptly into general form, it may be reworded as follows: Having given any profile for a steel pipe line and an approximate mean diameter resulting from the service demanded, find the relative diameters from point to point which will give a distribution of material throughout the length of a pipe line resulting in the smallest total weight of material.

It will be shown that the proper distribution of material for such a pipe of uniform factor of safety is secured by adjusting the diameter according to the previously mentioned inverse seventh root of the head, regardless of the total amount of head assigned for the purpose of overcoming friction. Inspection of the resulting equations will show also that the pipe line once installed according to this method has its material correctly distributed regardless of any change in service that may be later imposed upon it. For example, the quantity of water may be doubled or trebled by permitting greater friction loss, but the pipe is still correctly proportioned for the additional duty. The mathematical treatment is based on the following physical analysis:

Since the friction head, for a given amount of water flowing, varies directly with the length of pipe and inversely with the fifth power of the diameter, we may write

$$h_f = k\,(l_1\,d_1^{-5} + l_2\,d_2^{-5}) \qquad (1)$$

where h_f is the friction head, l is the length of any portion of the pipe and d is the diameter throughout the portion l. The subscripts refer to any two portions of the pipe line that may be chosen for comparison. It may also be said that the weight of material in a steel pipe of constant factor of safety depends directly upon the head and length and varies with the square of the diameter. We may therefore write

$$w = k'\,(h_1\,l_1\,d_1^2 + h_2\,l_2\,d_2^2) \qquad (2)$$

where w is the weight of the pipe and h the head for which the length l is designed.

Equation (1) shows the way in which the friction head is influenced by the length and diameter of the pipe. Equation (2), in view of the meaning of the previous equation, shows the manner by which the friction head influences the weight of material in the pipe, by introducing the only other factor affecting the weight—namely, the direct relation between head and thickness of pipe.

From the above analysis it may be correctly inferred that any relation between diameter and head which will result in a mathematical minimum for the total weight in equation (2) must be the relation sought. Equating to zero the first partial derivatives of w with respect to d and solving for the ratio of diameters in terms of the ratio of heads, we derive the following relationship; for minimum weight,

$$\frac{d_1}{d_2} = \sqrt[7]{\frac{h_2}{h_1}} \qquad (3)$$

From equation (3) it can be concluded without further transformation that, for the conditions stated (that is, minimum weight and constant factor of safety) the size of any high-pressure steel pipe should vary throughout the profile in such manner that the diameters at all successive points will be in inverse proportion to the seventh roots of their respective pressure heads. This conclusion is thus reached without statement of purpose of pipe and without mention of unit cost.

Multiple-Span Suspension Bridges

A discussion of the possibilities and advantages of using horizontal tie cables between the tower tops to limit deflection from unbalanced loads

By E. F. KEUSTER
Engineer with Waddell & Hardesty, Consulting Engineers, New York City

SUSPENSION BRIDGES have always been limited in their use to crossings where one span was required or could be used. With the growing tendency to construct highway bridges where they are needed, regardless of length of crossing, we are face to face with the question of eliminating the suspension bridge from consideration or of developing it in some form suitable for long crossings. It would seem grossly wrong to adopt the first alternative, of eliminating consideration of suspension bridges for such locations, unless it is absolutely necessary, because two principal peculiarities of the long highway bridge—a relatively small live load and a relatively large permissible deflection—are especially favorable to the use of suspension bridges. Studies which the author has made have convinced him that it is quite possible to build suspension bridges of more than one span, and that if tie cables are used between the tower tops to prevent excessive movement of the towers and deflection of the spans from unbalanced loads, the resulting structures will be both economical and practical.

Towers massive enough and stiffening trusses rigid enough to care for the unbalanced loading of multiple-span bridges can of course be used, but they would be prohibitively expensive. The following discussion is presented to show that multiple-span suspension bridges can be built economically with any number of spans, with spans of varying length and in combination with draw spans. Since the economic minimum length of span for multiple-span suspension bridges is shorter than for ordinary single-span structures, the proposal of multiple-span bridges with tie cables affects the whole range of highway structures, except for those locations where only one main span is required or where the spans are very short. Moreover, it is believed that the idea not only invades the field of present types of highway bridges but also opens up a new field where up to now no bridge was possible—for example, in a location where intermediate piers are required but where these piers are spaced so far apart that neither cantilever nor arch construction would be economical.

The proposal to use cables connecting the tops of suspension bridge towers, although not well known, is not new. In recent years two prominent American bridge engineers have applied for patents on the system, only to find that it had been patented in France in the year 1835. The writer knows of only one structure actually built in which tie cables have been used—namely, the bridge over the Loire at Montjean, France, built in 1927, and described in *Le Génie Civil*, Oct. 8, 1927. This structure has four main spans of 300 ft. each and two side spans of 163 ft.

Several studies and preliminary designs of multiple-span suspension bridges of various sizes have been made by the writer as an employee of the firm of Ash, Howard, Needles & Tammen, Kansas City, Mo., and of the firm of Waddell & Hardesty, New York City. The estimates showed a considerable economy (as high as 20 per cent of the total cost) as compared with cantilever, continuous or simple-span layouts or arches. One of the outstanding results of these investigations was to show that a multiple-span suspension bridge with any number of consecutive spans requires but slightly heavier anchorages than does a single span of the same length as any one of the multiple spans. Thus the cost of anchorages, usually a large item in the total cost of a conventional single-span suspension bridge, is a comparatively small item in the total cost of a multiple-span suspension bridge. In another of the economic studies it was found that a considerable saving could be effected in the application of three suspended spans of 333 ft. each without side spans, as compared with a layout of three simple trusses of the same length.

Peculiarities of the multiple-span suspension bridge

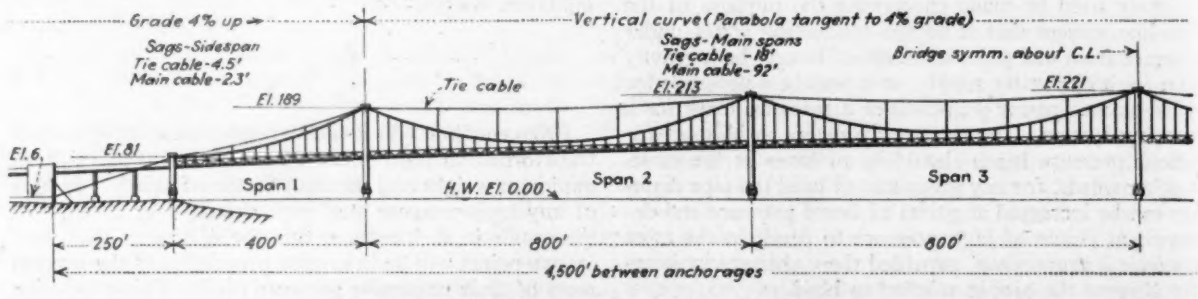

Fig. 1—Multiple-span suspension bridge with tie cables

Tie cables limit the deflection from unbalanced loads and depend for their proper functioning upon a considerable amount of prestressing.

are exemplified in the accompanying illustrations. Fig. 1 demonstrates the more frequently encountered case, with main spans of equal length. In this design all stiffening trusses are made two-hinged to simplify the calculations, despite the writer's belief that continuous trusses are more economical and produce a greater rigidity. The sag of the main cables in main spans is 92 ft., giving a sag-to-span ratio of 1 :8.7. This is rather large as compared with recently built suspension bridges in which it has been considered good practice to use a small sag in order to attain maximum rigidity. The rigidity of a multiple-span suspension bridge chiefly depends, however, on the tie cables, and it is the writer's belief that sags up to one-eighth or one-seventh will prove economical for these bridges.

The cables are assumed not to be continuous over the supports. This is directly contrary to practice in ordinary suspension bridges but has its advantages for multiple-span suspension bridges with tie cables. In a suspension bridge without tie cables the horizontal pull is always the same throughout the length of the bridge. (In bridges with fixed towers the pulls may vary, but the difference is not great.) In suspension bridges with tie cables, on the other hand, the total horizontal pull of tie cable and main cable is the same throughout the length of the bridge and equal to the pull in the backstays, but so far as the tie cables alone or the main cables alone are concerned, the pull may be quite different in adjacent spans. This means that at the tower tops one part of the pull has to be transferred from the main cable to the tie cable, or vice versa. The most expedient way to accomplish this seems to be to cut the cables at the towers and to provide an ordinary strandshoe for each cable strand, attaching all the strandshoes to a common casting fixed to the top of the tower. This casting will not be too large and clumsy so long as the cables can be made of three strands or less. (In the demonstrated layout, Fig. 1, the backstays and main cables consist of three strands and the tie cables of one strand each.) For a highway bridge with a 20-ft. roadway three strands will be sufficient up to approximately 800-ft. spans. For longer or heavier bridges the use of eyebar chains, which are easily attached to the tower tops, will provide the simplest and best solution.

Recently, cables made of ready-fabricated twisted strands came into use for suspension bridges, competing with parallel-wire cables, which have to be spun at the bridge site. Such prefabricated cables have been used on the Grand' Mere bridge in Quebec and on the St. Johns bridge at Portland, Ore. Before placing such strands on the towers they are artificially prestretched by jacks in order to take out as much as possible of the inelastic elongation, and thus increase the modulus of elasticity of the strand. The use of such strands will be especially convenient for main cables of multiple-span suspension bridges because the attachment of them to the tower tops can be more easily made than can the attachment of parallel-wire strands. For the tie cables the highest possible modulus of elasticity is essential, so that parallel-wire cables will be best for this service, although prestretched strands may be considered.

Design—The structure shown in Fig. 1 is statically seven-fold indeterminate. Each of the six tie cables can be considered as a redundant member, and if all the six tie cables were removed, we would still have a suspension bridge which, no matter whether it has one main span or more, is statically one-fold indeterminate. If continuous stiffening trusses are used, we would have one more indeterminate at each support. The method of analysis for such a structure is the usual one for statically indeterminate structures—namely, by the application of the theorem of virtual work as given by Müller-Breslau and others.

Present-day suspension bridges are computed by the deflection theory, which takes into account the deformation of the loaded structure and the effect of the dead load upon the deformations. The calculations for even a single-span bridge are very involved, and the difficulty increases, of course, with multiple-span bridges. However, for the sake of economy, such calculations may be justified. For the tie cables these calculations are simplified by the fact that only whole spans have to be loaded.

Stiffening trusses should be calculated by the elastic theory and some deductions made to secure approximate agreement with the deflection theory. The amount of deductions will be found from the results of investigating

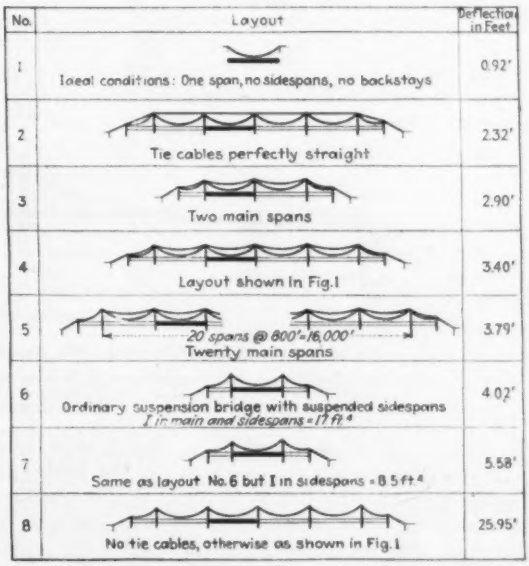

Fig. 2—Deflections at center of loaded span for various layouts

One span only is loaded in each layout with 450 lb. per linear foot of truss. Dimensions of cables in all layouts are the same. All main spans are 800 ft. each and all side spans 400 ft. Trusses are two-hinged. Moments of inertia for all main spans are 17 ft.⁴ and for all side spans 8.5 ft.⁴, except as noted for layout 6. *The deflections are computed by the elastic theory; by exact theory they would be somewhat smaller than shown.

the tie cables by the deflection theory. A load applied in one span will produce a considerable "compression" or slackening in the tie cable of that span, and in all other spans produces tension in the cable. A uniform load over the whole bridge produces practically no stress in the tie cable, because the total positive and negative areas of the influence line are almost equal. Thus it can be seen that, when only one span is loaded, the unbalanced pull of the main cables at adjacent towers is largely taken by "compression" of the tie cable of the loaded span, and only a small amount of it is carried by tension through the other spans to the anchorages. The greater the number of spans the smaller is the amount of tension carried to the anchorage. This accounts for the fact that bridges with tie cables can be designed with an unlimited number of spans without losing much of their rigidity.

To meet and offset the sag in the tie cables it is necessary to provide them with an initial tension stress. This

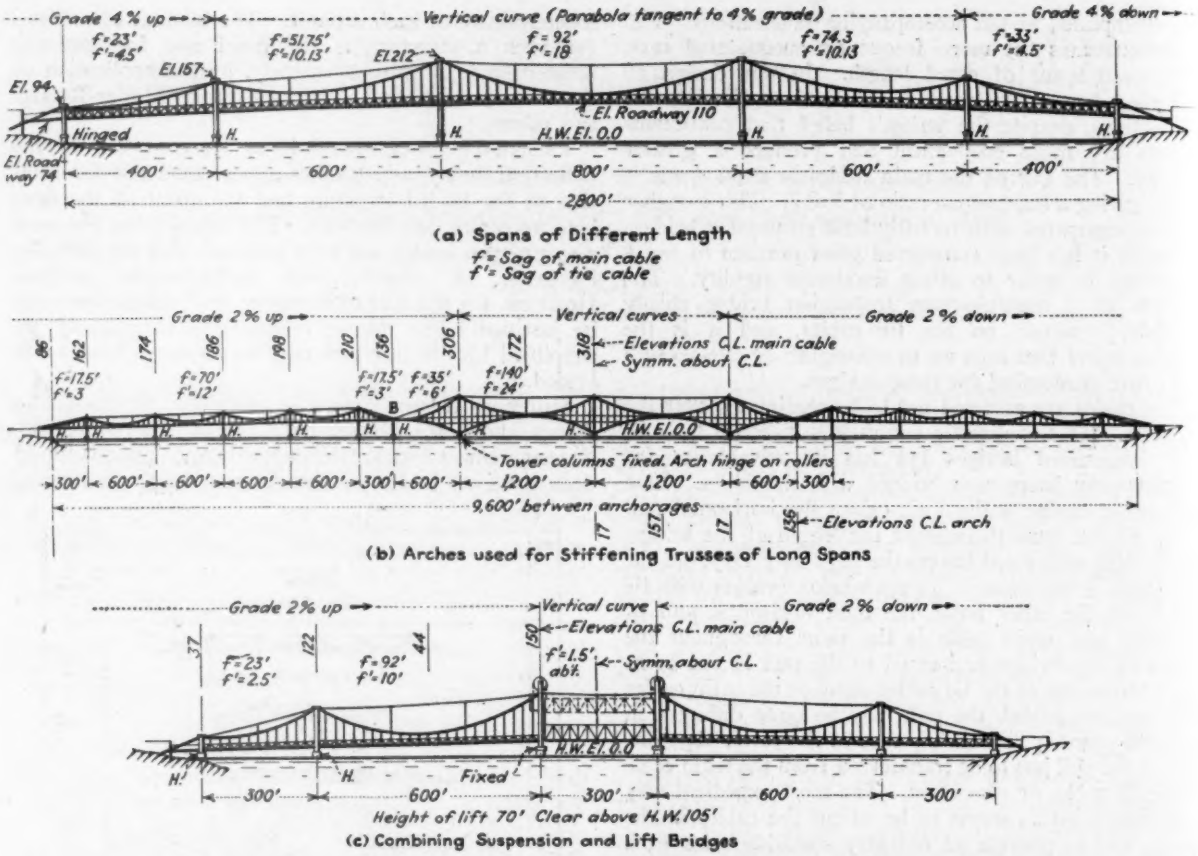

Fig. 3.—Layouts indicating the wide possibilities of arrangement using multiple-span construction

By the use of the expedient shown in *b* it is not necessary to carry the large horizontal cable pulls of the main spans into the shore anchorages. At point *B*, where the arches are connected to the cables, there is only sufficient horizontal thrust toward the shore to balance the cable pull of the small spans.

initial stress, which corresponds to the tension under normal conditions with no live load on the bridge and at normal temperature, has to be equal to the amount of compression that can be produced by live load plus the compression due to temperature rise plus some amount which is required as a minimum tension in the cable to keep it from sagging down from its own weight. A large initial stress in the tie cables is an important factor in the rigidity of multiple-span suspension bridges. In order to show their rigidity, the deflection of the loaded span for eight different layouts—with and without tie cables—has been calculated, and the results are given in Fig. 2. From this tabulation it can be seen that the bridges with tie cables, no matter how many spans are in the layout, are more rigid than the conventional suspension bridge with suspended side spans. Comparing layout 2 with layout 4 shows the value of perfectly straight tie cables and indicates that the sag of the tie cable should be kept as small as practicable. Naturally, the tension in the tie cables depends upon the erection method used. With modern hydraulic jacks it should not be difficult to prestress the tie cables to almost any desired amount.

In Fig. 3*a* is shown a bridge in which spans of different length were required. For a very long bridge, where only one or two long spans are required and where there are long stretches of water which must be bridged by smaller spans, it would be wasteful to carry the large horizontal pull of the cables in the long spans to anchorages on shore. For such a condition the scheme shown in Fig. 3*b* is advisable. It represents approximately the layout considered by the writer some time ago for a bridge over San Francisco Bay. The arches in the main spans serve three purposes: First, they act as stiffening trusses, no other stiffening trusses being used; second, they take part of the load, thus reducing the pull on and, therefore, the section of the cable; third, they produce, at points *B*, a horizontal thrust directed towards the shore and, being connected to the cables at this point, the cable pull of the long spans is neutralized to a great extent, leaving only such amount unbalanced as is necessary to balance the cable pull of the small spans. Thus, there is an equilibrium of horizontal forces at points *B* as well as at all other supports, and no pier has to take any horizontal loads. The stiffening trusses in the main spans can of course be raised partly or wholly above the roadway, to provide a greater clearance for navigation. Also in place of arches a horizontal stiffening truss can be used to carry the thrust; such construction adapted to one-span bridges is frequently used in Germany.

In Fig. 3*c* is shown a combination of a multiple-span suspension bridge with a draw span. For the draw span a vertical lift span is chosen as most convenient in this combination, because the towers needed for a vertical-lift bridge are here already furnished by the suspension bridge. A respectable example of such a bridge combination is the Tower Bridge in London, where, however, a double-leaf bascule is used instead of a lift span. Also, instead of using tie cables in the suspended spans, the rigidity of the Tower Bridge is provided by heavy steel towers incased in masonry, supplemented by tie rods between the towers over the draw span.

Flood Control on Alluvial Rivers—II

By T. H. JACKSON
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President, Mississippi River Commission, Vicksburg, Miss.

A survey in three articles of the planning problems, methods of flood control and types of flood-protection works, with particular reference to flood control on the Mississippi River

✦

Methods of Flood Control

PROCEDURE in determining the problem and general engineering plan of flood control, discussed in the preceding article, is here followed by definition and appraisal of methods. This discussion covers levees, reservoirs, diversions and the minor methods of dredging and shortening. Clearing and reforestation are given consideration. —EDITOR.

IN DECIDING ON a flood-control plan, careful consideration should be given to every possible flood-control method or combination of methods. There should be no prejudice against any method, but each should stand solely on its merits, judged primarily by the results it will give and the cost it will entail.

It is probable that failure to appreciate the difference between the flood problem of the alluvial and the non-alluvial river has led to the almost universal practice of trying to make the alluvial river carry all its flood waters in one channel. This method is normally referred to as the "levees only" method. However, since levees offer the only method that alone can take care of all the flood waters of a large alluvial river, it may be said that control of floods by levees is the standard method.

There are, however, a number of methods which serve in varying degrees as aids to levee control; these are reservoirs, diversion, dredging, shortening the channel, clearing the channel, etc. These methods and many others, as agitation to produce scour, removal of silt content and reforestation are also offered as methods adapted to complete control.

The Levee Method

The use of levees (probably dating back thousands of years) is the oldest, most common and best-known method of flood control. It is the only method which can alone be used to solve a major flood problem. The use of any other method, except as an aid to the levee method, has been most unusual.

Where protection against only minor floods is sought —and that is the only protection that is in general economically justified for any but highly developed areas—the "levees only" method is normally the only sound one. Being a method that can be applied in whole or in part and that can be extended to any desired capacity with little change of plan or loss of original investment, it has naturally furnished the generally accepted solution, and in general has been the only possible economic set-up. In other words, it is normally the most applicable, most satisfactory and least expensive method.

An important advantage of the levee system is that by retaining the floodflow a new bankfull stage is created. This in turn brings about an increase in the channel cross-section and in consequence an increased discharge capacity. The extent of this increase is indefinite, but there is no doubt about its being material. It probably increases progressively and for a long time after there is complete levee control. The increase is limited to that which can be maintained by the new bankfull (levee-full) discharge.

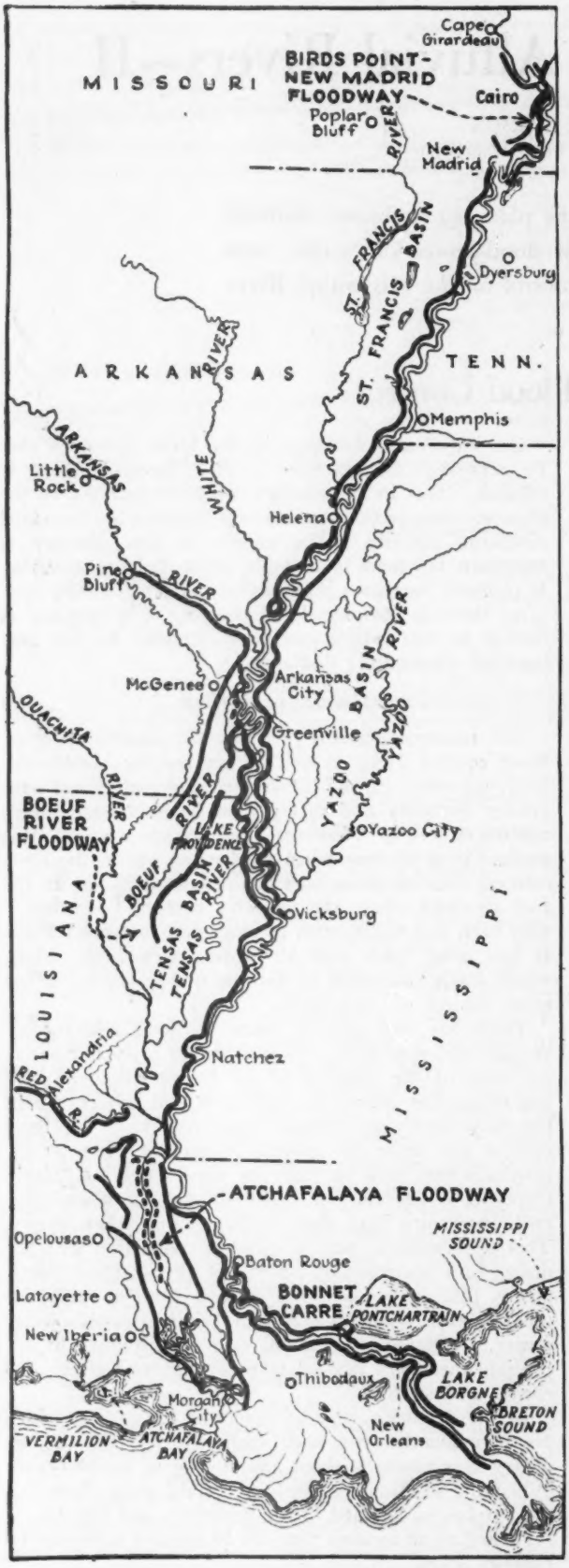
Reservoir Method

The reservoir method provides the soundest plan of flood control from a strictly engineering standpoint, since reservoirs can be constructed and maintained with greater certainty and safety than levees or any other control structure. However, due to excessive cost, this method is at its best when used as an aid to the levee method. Its excessive cost has restricted its use in the past to cases where the property protected has had a very high unit value, such as cities and industrial areas. It has never been used to protect agricultural lands, which lands constitute by far the major portion of all areas subject to river floods.

There are two general types of flood reservoirs—storage and detention. In the former all water up to the limit of the capacity of the reservoir can be held and released as desired through controlled outlets. About the only difference between reservoirs used for flood control and those for general storage of water is the provision that must be made for rapid emptying. Rapid emptying is necessary in flood-storage reservoirs, since such reservoirs have their highest value when empty. This point must be kept in mind in connection with the design and operation of reservoirs of this class, for it means that such reservoirs have a limited value for other useful purposes—domestic water supply, water power, irrigation, navigation, etc. The failure to appreciate this point has led to many unsound claims for cheap flood storage.

In the detention type of reservoir the outlets which are permanently open have such capacity that the ordinary flow passes without any storing in the reservoir. When the discharge exceeds a certain stage, however, the surplus is detained in the reservoir, and the flow is regulated to an amount that can be carried safely in the channel below

The possibility of reservoir storage for the control of floods dates back in this country to the time when



Levee and diversion system of Mississippi flood protection adopted by act of Congress approved May 15, 1928

Ellett in 1852 recommended its use for the control of the floods of the Mississippi River. The reservoir system at the head of the Mississippi River may have been a direct outcome of his report. This system has a capacity of over 2,000,000 acre-ft. It cost about $1,300,000. It has the lowest unit cost of any system, large or small, in this country. If operated solely for the control of floods of the Mississippi, the effect at Cairo, 1,300 miles below, would be negligible.

The reservoir method has been used as the basic method in connection with the control of the floods of the Miami River, which project was completed about 1923. The plan, now under construction, for the protection of the city of Los Angeles provides for the use of both reservoirs and levees. Both of these systems are small. They are, however, the only ones of note that use reservoirs.

There are two principles governing the location of reservoir storage, the importance of which is not in general appreciated.

1. The value of storage at any point varies inversely with the distance of this point from the area to be protected. There is a marked tendency, in discussing the value of storage, to neglect this principle.

2. Reservoir storage at any point has the same value as channel capacity up to an amount equivalent to the discharge provided for by the plan at that point. Storage above that discharge has a very rapidly decreasing value.

For instance, if the estimated maximum discharge of a tributary is 400,000 sec.-ft. under the flood plan, storage which will reduce the flow from the tributary by 400,000 sec.-ft. is the equivalent of 400,000 sec.-ft. of channel capacity in the main river. Storage above 400,000 sec.-ft., however, can be given little value.

Diversion Method

By "diversion" is meant permitting or forcing a portion of the flow to leave the waterway at a definite point and carrying it in a separate floodway to a lower point, or to some other watershed. This floodway may or may not be leveed. In the Sacramento River project there are two main and three secondary diversions. The water is in all cases returned to the main river at points below. In the plan for the Mississippi River there are four floodways, one of which returns the water to the main river.

Where complete protection is to be given a large alluvial river, particularly in its lower portion, against great floods (including the maximum probable), the most promising method will ordinarily be that of levees with diversions. Under such a plan as great a portion of floodflow as is possible should be held in the main channel between levees of moderate height. The balance of the discharge should be taken care of by diversion. Diversion floodways are practicable on alluvial streams because the troughs of the basins are lower than the banks of the river. A large volume of water can, therefore, be carried through these basins in leveed floodways at small cost compared to the cost of carrying it in the main river between high levees. It can be carried too with much greater safety, and, when the levees reach a certain height, safety becomes the guiding consideration, irrespective of cost.

Such diversion floodways are in the natural basins which parallel the main river throughout most of its length. Before the river was leveed these basins received the overbank flow when the river was in flood

and passed it down toward the river's mouth. It will be seen, therefore, that in the use of diversion floodways there is being used what nature provided and has used for ages in caring for the excess flood waters. In other words, the struggle is not to hold all flood waters at high elevation in the main channel by means of levees of great and unsafe height, but to hold there only what can be held by levees of reasonable height and to let the balance be carried through the natural overflow basins, leveed or otherwise.

Diversion Method

The diversion method is one which has been advocated for many years. Ellett recommended it for use in connection with the control of the floods of the Mississippi River in his 1852 report. The first time this method found a place in an important plan was in the 1894 plan for the control of the floods of the Sacramento River, prepared by Marsden Manson and C. E. Grunsky, consulting engineers for the state of California. Its first use in this country in an adopted plan was in that for the control of the floods of the Sacramento River prepared in 1907-10 by the California Débris Commission, which plan was adopted by the State of California about 1911 and by the United States in 1917.

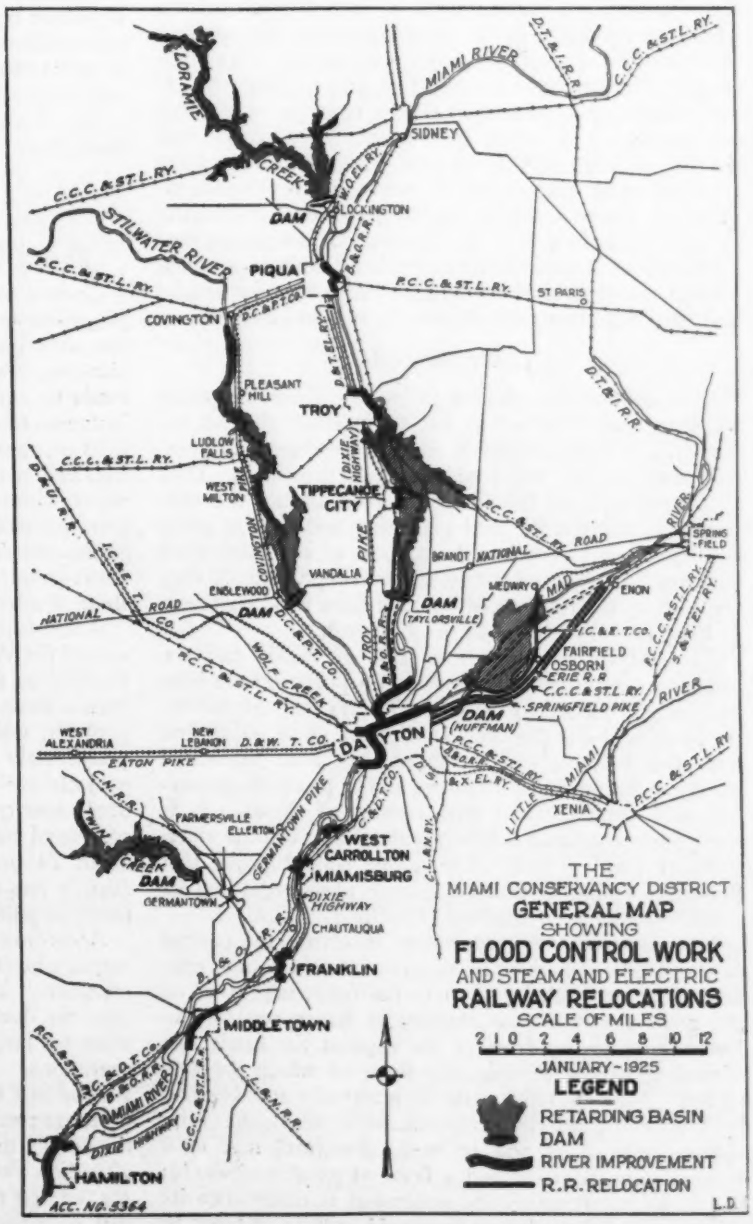
Dredging Method

This method contemplates an increase of the existing channel capacity at a given point by dredging. Due to the excessive cost of construction and maintenance, the use of this method is very limited and in general is confined to the local treatment of stretches where the increase in discharge capacity cannot be gained and maintained at equal cost by any other method. Since in dredging there is simply an increase in the channel section without the increased flow necessary to maintain it, it is to be expected that there must be continuous maintenance. As a method of increasing the river capacity throughout, as is often advocated, it has no place in flood control because of its excessive cost.

Channel Shortening

This method provides for shortening the river channel by cutting across bends. The result of such cutting is to increase the slope and discharge in the stretch of river affected. Where the bend forms a natural constriction it may be advantageous to remove the bottle-neck conditions by a cutoff and to give to the stretch a normal discharge capacity. Any increase in discharge beyond that capacity, however, can serve no useful discharge purpose in a flood-control plan. Cutoffs may cause serious and undesirable local disturbance by setting up cross-currents and high velocities, which may cause serious injury to the channel, banks and levees immediately below. Under no conditions should a cutoff be made until provision is made against such conditions.

The cutoff method is one to be approached with great caution and with the main objective of producing a channel which will be less expensive to maintain rather than one having increased capacity. In its natural condition a bend is under constant threat of cutoff at its neck by natural erosion. To avoid such an occurrence and particularly where there is fear of injury to channel, banks and levees below, it is usual to protect the bend from cutoff by a levee extending from the main system across the neck onto the point, and by revetment works on one or both sides of the neck, particularly the upper side. Such works are in general very expensive, due to original cost and never-ending extensions of both the levee and revetment. Furthermore, both the levee and the revetment are subject to heavy attack and the maintenance is heavy. Again, it may be necessary



Detention reservoir system for flood protection of the cities of the Miami River valley in Ohio

Reproduced from the technical report of the engineers of the Miami Conservancy District on construction plant methods and costs.

to extend the levee such a distance that a bottle-neck condition is aggravated.

In flood-control plans of the past the cutoff has played an unimportant rôle, and there is little prospect of it playing a more important one in the future. In carrying out the Sacramento River plan, cutoffs were made at several points. It is the opinion of those who have known the river before and after these cutoffs were made that the sum total was not beneficial. In revising the project about 1922, previously proposed cutoffs were omitted.

Clearing Method

The clearing method has for its object an increase in flow. A cleared floodway will carry from about two to three times as much water as an uncleared one. Between the river and the levees and on the islands in the river there is usually a heavy growth of timber which reduces greatly the velocity of the overbank flow. To secure a greater flow it is frequently proposed to clear these areas. The principle is much like that of dredging. If the work is not permanent, there must be continuous maintenance. If made permanent, then there will follow reduction of channel to a section which the river flow will maintain. In other words, no permanent increase in channel section can be expected by dredging or clearing, unless there is provided an increase in flow proportional to the increase in section. Both the clearing and maintenance costs are so high that except for special and very local treatment clearing is seldom justified.

Other Methods

Such methods as agitation to increase channel capacity by deepening, removal of silt to increase channel capactity, and reforestation do not merit serious consideration since they are not based on sound principles. They all disappear from the picture as soon as they are submitted to the test of cold reasoning and cost is given consideration. None has the support of reputable flood engineers. They are mentioned here simply because they are so frequently advanced by other than flood engineers as basic or aid methods to flood control.

The use of forests for control of floods and the agitation for reforestation for such a purpose have been so widely discussed in the past 30 years that the following is offered for the consideration of those unfamiliar with the subject. Reforestation has been advocated widely in both popular literature and in public documents for both complete and part control of floods. It is always proposed as a solution without any definite statement of plan or cost. This alone should prove that those advocating it have no definite ideas regarding its results or cost as a flood-relief method.

In considering any proposition involving the control of the floods of a river by means of reforestation, consideration may well be given to the following: One of the great floods of the Mississippi River occurred in 1844. For the upper river the gage at St. Louis had a reading higher than in any flood of which there is record. Now in 1844, little or practically nothing had been done toward the deforestation of the upper Mississippi valley. It will be seen, therefore, that in a natural state the river had a flood of great magnitude; and if by reforestation the watershed is restored to its original condition, the river should still be subject to a flood as great as that of 1844. It is obvious, therefore, that to eliminate floods by reforestation the reforested area must be much greater than that which existed prior to the arrival of the white man. The acreage of the deforested area of the Mississippi River above Cairo is about 52,000,000. The value of this acreage is not known, but considering the fact that it represents the most valuable land of the natural wooded areas, a conservative estimate would be $200 per acre. This estimate does not seem high when account is taken of the many towns, cities and industries involved. The cost, therefore, of this area should be at least $10,000,000,000. When the reforestation of this 52,000,000 acres is completed the flood situation should be the same as that of about 1844. If a greater area must then be placed in forests, it must come from the 350,000,000 acres of prairie land of the upper Mississippi valley which never grew trees; hence, it would probably require irrigation before tree growth could be obtained. Incidentally, there are about 20,000,000 acres of land in the alluvial valley, of which only about 5,000,000 acres are cleared. The protection of this 5,000,000 acres through reforestation of more than 50,000,000 acres does not seem to warrant serious consideration.

The third and last article will discuss in detail the flood-control works on the Mississippi River.

Power Commission Reviews Year's Activity

Control over water-power developments is declared to be primarily a responsibility of the individual states in the tenth annual report of the Federal Power Commission, recently made public. The report cites complaints made by state authorities that the government in some instances has been inclined to encroach upon the rightful field of state activity to such an extent that confusing duplication of authority occurs. In this connection the report points out that "clearly the government has the principal obligation of safeguarding the interests of navigation and the federal properties that may be affected by water-power projects, but in other respects the control of these developments is largely a matter of state interest."

Activities of the commission to date have mainly concerned the Western states, since very few of the projects licensed so far are east of the Mississippi River. California alone accounts for more than a third of the 449 projects, while the three Pacific Coast states have approximately half the total. Less than 10 per cent of the projects are found east of the Mississippi River. The total capacity of all the licensed plants which have been completed now amounts to 2,608,868 hp., equivalent to about 24 per cent of the hydro-electric capacity and slightly less than 6 per cent of the total generating capacity in public utility service throughout the country.

According to the report, the end of the year finds "the primary business of the commission in a very satisfactory condition," and "through efforts made during the past year the docket has been practically cleared of applications for large projects contemplating early construction operations. . . . Production statistics for 1929 show, for the first time in ten years, a failure of hydro-electric power to record a gain in output. During the same period the energy manufactured by fuel plants increased nearly 10 billion kw.-hr. Preliminary figures, based on records for the first nine months of the calendar year 1930, show that notwithstanding the current business depression the total electric production for the year will practically equal the 1929 output, but the proportion generated from water power promises to be even less than in 1929."

Repairs Inside 54-In. Steel Water Pipe Made Under Pressure

Pipe interior examined by use of sliding air lock from which diver located break and welder made repairs

By J. S. LONGWELL
Assistant Chief Engineer,
East Bay Municipal Utility District, Oakland, Calif.

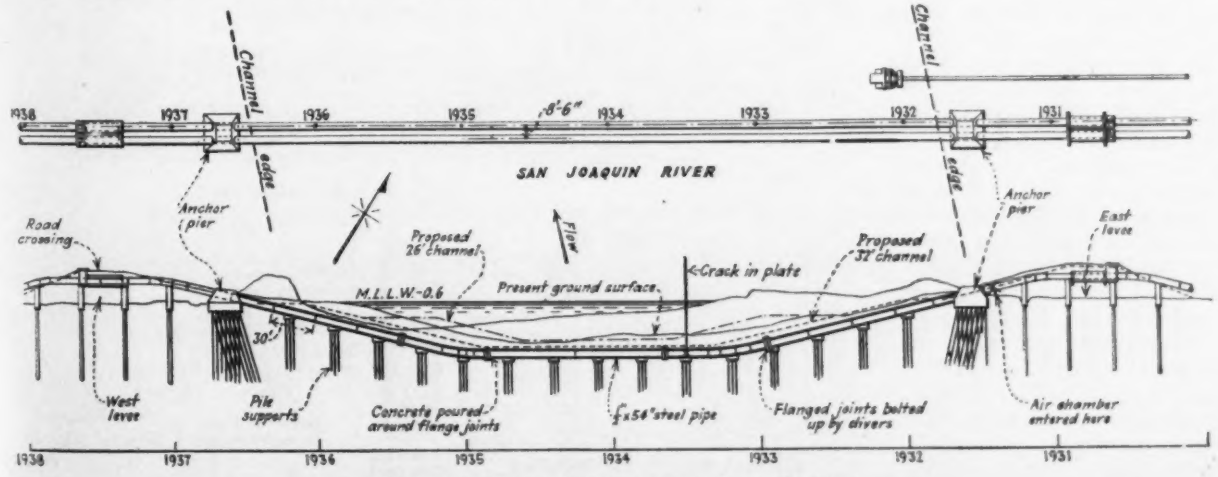
THE AQUEDUCT recently built by the East Bay Municipal Utility District to convey water from the Mokelumne River to cities on the east side of San Francisco Bay crosses the San Joaquin River in an inverted siphon about 600 ft. long. At this point the line consists of two steel pipes, each 54 in. in diameter, made of ½-in. steel plates and coated on the outside with 4 in. of gunite. At low-water level the siphon at the low point is under an external pressure of about 40 ft., the internal pressure in the pipe at this point under ordinary operating conditions being about 230 lb. per square inch. The pipe was fabricated in 30-ft. lengths made up of two semi-cylindrical sections joined by two electrically welded seams. Description of the construction of this pipe line was published in *Engineering News-Record*, Dec. 2, 1926, p. 912.

After the San Joaquin River siphon had been laid, but before it had been connected to the pipe over the levees, it was tested for leakage under a pressure of 230 lb. per square inch. These tests showed that the north pipe was leaking at the rate of only 94.07 gal. per minute per 24 hours, whereas in the south pipe leakage was at the rate of approximately 24,000 gal. per minute per 24 hours. The method of finding the leak in the south pipe and its successful repair are described in the following.

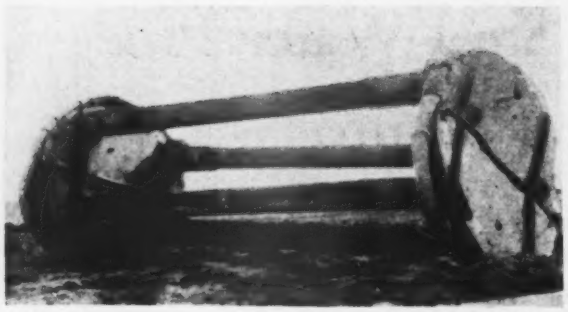
An inspection of the submerged pipe in which the excessive leakage occurred, made by divers both inside and outside the pipe, showed that the flanged joints were all up tight and that all riveted joints appeared to be in good condition. The inspections inside the pipe were made with the pipe full of water, as the pipe trench was not yet backfilled and the pipe was subject to flotation if emptied. The diver used a light and examined the pipe and joints as carefully as possible, but as the pressure was the same inside and outside there was no flow through the leak and nothing was found. Inspection on the outside was somewhat difficult, as the pipe was on the pile bents with the bottom of the pipe in all cases several feet above the bottom of the trench. The diver went over the pipe as well as he could but was unable to find any indication of a leak, although the pressure was maintained in the pipe during this outside inspection.

In order to make a detailed inspection, foot by foot, of the inside of the pipe in the dry, a pneumatic chamber or air lock was constructed in such way that it could be moved through the pipe, stopped at any intermediate point and there unwatered, so that a man within the air lock could make close visual inspection of the inner surface of the steel plates and locate the leak by inflow from the outside.

The air lock consisted essentially of two wooden bulkheads 9 ft. apart connected by a framework of 4x6-in. timbers. The function of these bulkheads was to make tight joints against the inside of the pipe shell, thus permitting the space between them to be unwatered by pumping in compressed air, which forced the water out through valves in the bulkheads. Details of the air-lock design are shown in the accompanying illustration.



Plan and profile of the San Joaquin inverted siphon



Simple frame used to form air lock inside the pipe

The circular bulkheads were made up in two parts, the lower half being rigidly attached to the 4x6-in. framework and the upper half hinged so it could be laid back, allowing the chamber to be moved freely inside the pipe and to permit the diver to enter and leave the chamber. The bulkheads were made up of 3-in. lumber, covered on both sides with rubber sheeting to make them watertight. Four heavy strap hinges were set on the outside, and in the joint between the two halves of the bulkhead a fold of rubber sheeting was put in and fastened to both halves of the bulkhead to prevent leakage through the joint.

Around the outside of the bulkhead, to make a watertight joint with the inside of the pipe, a 3-in. double-braided fire hose was used; the ends of this hose were clamped together and a tire valve was vulcanized into the fabric so air could be used to inflate the hose. The hose was fastened to the lower or fixed half of the bulkhead by means of canvas strips or loops nailed to the bulkhead on a spacing of about 5 in. between centers.

On the upper half of the bulkhead special provision was necessary to permit the hose to be removed so the hinged half of the bulkhead could be swung open. To serve this purpose, two ¼-in. steel plates were cut to fit the arc of a 54-in. circle and were fitted to either side of the movable half. On the outside of each bulkhead the plate was bolted permanently in place. On the inside each plate was fastened on with bolts passing through slots, which permitted the plate to slide inward toward the center of the bulkhead after the nuts had been loosened. Thus, when the inner plate had been loosened and slipped down, the hose could be removed from this half of the bulkhead.

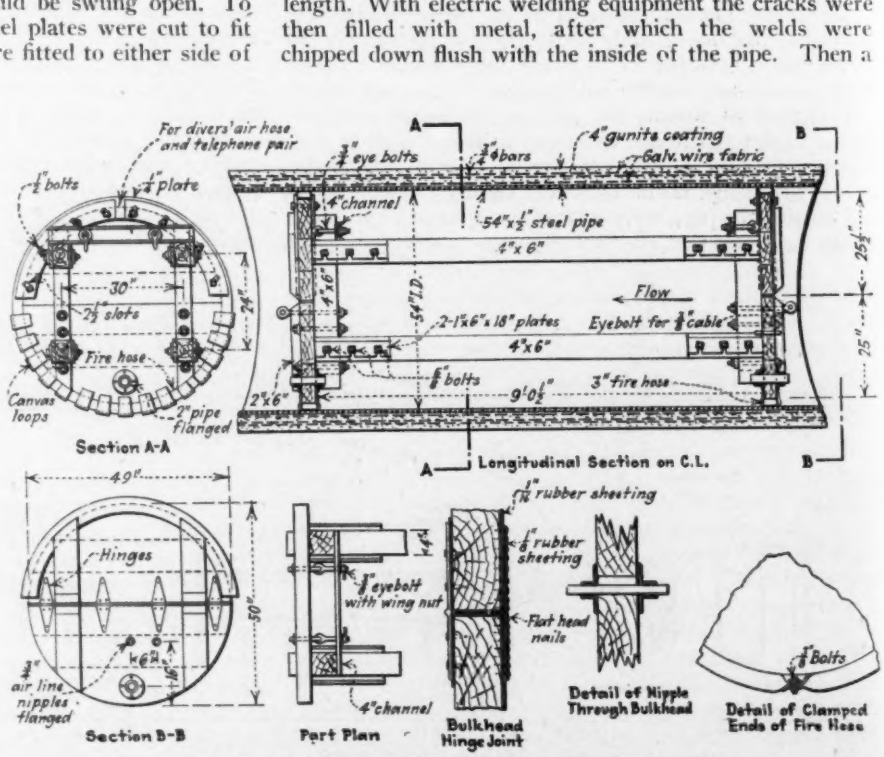
Each bulkhead was pierced with 2-in. pipe nipples through which water could escape when the inside of the flooded chamber was subjected to air pressure. These outlets were equipped with check valves. Through other openings in the bulkheads were connections carrying air pipes, telephone wires and wires carrying current to be used in lighting and in electric welding. All openings carrying these services were calked with oakum from the inside before the pumping out of the chamber was started.

The procedure in operation was as follows: The chamber was put into position at the east end of the siphon, and a diver went inside, closed the hinged part of both bulkheads, set the channel upon braces and securely tightened the nuts on the bulkhead bolts. The upper portion of the hose was then placed over the top of the bulkhead and steel restraining plates were slid into position and bolted. Air was next admitted to the hose, sealing the outside of the bulkheads against the inside of the pipe. Service openings through the bulkheads were then calked with oakum from the inside. An air inlet on the inside of the bulkhead was opened, and as compressed air entered water was forced out of the chamber through the 2-in. nipples.

With the air lock unwatered the diver was able to examine the inside of the pipe with the aid of an electric light. Not finding the trouble, the air supply into the chamber was shut off and water again admitted. The upper halves of the bulkhead were then opened so the chamber could be moved ahead 9 ft. The chamber was pulled along the pipe by means of ⅜-in. steel cables attached to I-bolts set in the permanently fastened half of each bulkhead and extending to hand-operated winches on the river bank.

This succession of 9-ft. advances was continued until about 200 ft. of the line had been examined, working from east to west, without encountering any leakage. At this point a crack in the pipe shell was found at right angles to the upper longitudinal weld and extending on either side of it for 5 or 6 in. This examination and location of the leaks was all done by one diver working an eight-hour shift.

Repairs were effected by taking another compressed-air line into the chamber and, with the use of air-chipping tools, opening up the cracks by V-cuts for their full length. With electric welding equipment the cracks were then filled with metal, after which the welds were chipped down flush with the inside of the pipe. Then a



Details of bulkheads and frame constituting the air lock

½-in. plate 8x12 in. in size was set over the crack and the plate was welded to the pipe on all four sides. During these welding operations the diver and welder worked in the chamber at the same time with their helmets removed. Final treatment of the repair consisted of a coating of hot asphaltic compound.

On the outside of the pipe a crack of practically the same length and location was found in the 4-in. gunite coating. This was repaired by placing a concrete collar around the pipe. After these repairs were completed the pipe was again tested and found to show a leakage of only 172.5 gal. per minute per 24 hours, which was well within the allowable maximum amount set for this part of the aqueduct.

The air lock was devised and built by the Pacific Bridge Co., subcontractor under the Twohy Bros. Co. and the J. F. Shea Co., general contractors. Ralph T. Keenan was superintendent for the Pacific Bridge Co., and the writer was division engineer in charge for the East Bay Municipal Utility District.

Special Carfloat Used to Distribute Bulk Cement

Conveyors and compressed-air pumping system makes it possible to unload cars directly into storage bins or floating mixing plants

By MORRIS KIND
President Hercules Cement Corp., Philadelphia, Pa.

THE INCREASING USE of ready-mixed and transit-mixed concrete for construction in New York City is creating a major demand for bulk cement. Bulk-cement delivery to this great market is complicated by the fact that while most of the cement is shipped from the mills by railway, ultimate delivery with but few exceptions must be made by water. Specifically, cars of bulk cement are transferred from railhead to the point of delivery by carfloats, from which the cars are unloaded into the storage bins of waterfront, central-mixing or central-batching plants. Waterfront plants are a virtual necessity, not only for convenience of cement delivery but because nearly all deliveries of gravel, crushed stone and sand are made by water.

To secure quick, safe and economical bulk-cement delivery under the conditions indicated, the special bulk-cement cars and cement-handling carfloat shown in the accompanying illustrations have been constructed and have been in successful use since March 30 of last year. Fig. 1 shows the dimensions and mechanism of the carfloat and cars. Fig. 2 shows the carfloat deck and the deck conveyors into which the cars discharge through four hoppers on each side. Canvas chutes latched to both the car hoppers and the conveyor hatches provide a tight discharge spout from car to conveyor. Fig. 3 shows the car hoppers and deck conveyors (not connected by the chutes) and also the discharge pipe to shore storage from the pumps below deck. The general operation is as follows: The cement from the cars is discharged by gravity into a series of screw conveyors on the deck of the float parallel to the rails (Fig. 2), which, in turn, deliver it to cross conveyors located in the center of the float and below the deck. The cement is then discharged into a bin over the pumps, which, in turn, deliver the cement through a pipe line from either side of the float to the receiving bins on shore. A flexible hose makes

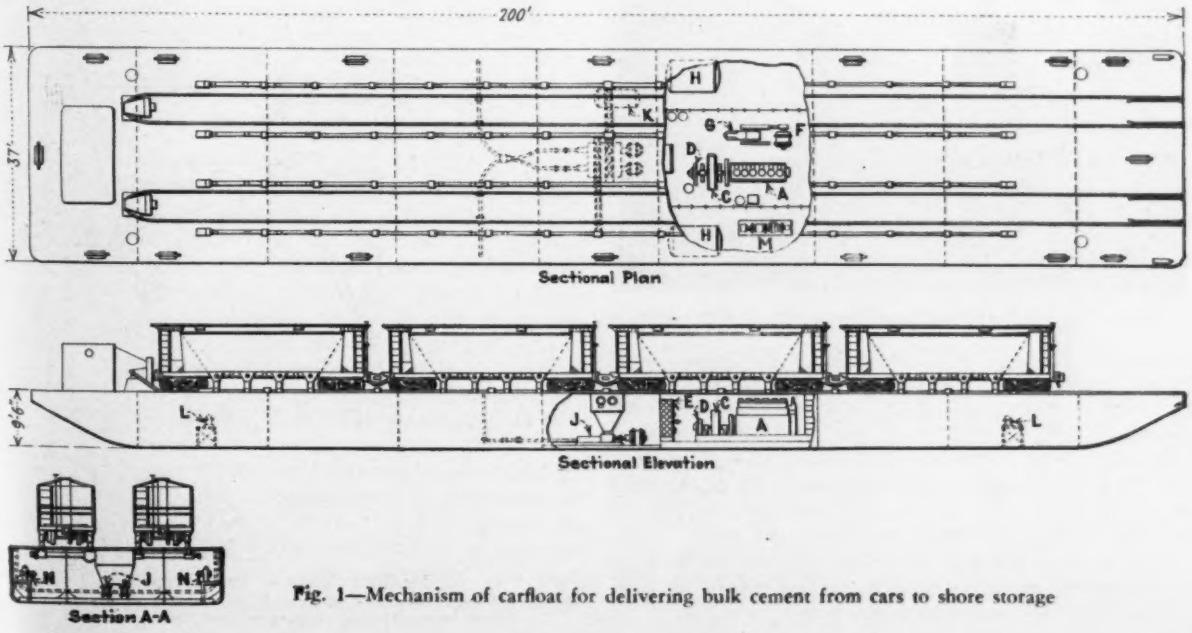


Fig. 1—Mechanism of carfloat for delivering bulk cement from cars to shore storage

the connection between the float and pipe line at the dock (Fig. 3). There is no loss of cement and no dust.

To make the carfloat independent of a shore connection for power, it is equipped with a diesel engine direct-connected to an electric generator. There is a motor-driven air compressor on board to furnish the required air for the pumps, which are also motor-driven. The conveyor and pumping equipment have a capacity of 225 bbl. per hour, requiring about sixteen hours to discharge the cargo of 3,500 bbl. of cement. To insure uninterrupted service, storage facilities on shore are provided for at least 5,000 bbl. of cement, and a simple conveyor and bucket-elevator installation rehandles the cement as required.

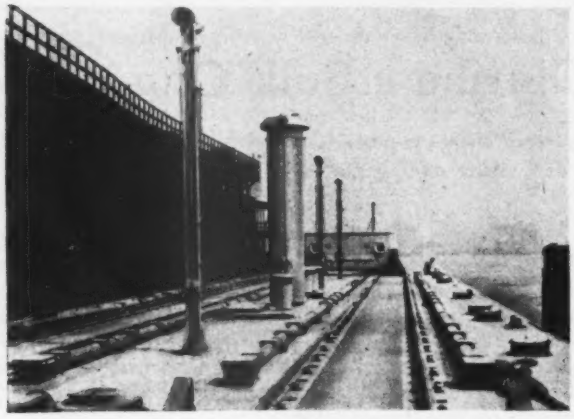


Fig. 2—Carfloat deck showing conveyors

Referring to Fig. 1, the equipment in detail is as follows: *A* is a 6-cylinder, 235-hp. diesel engine, direct-connected to *C*, which is a 15-kva., 220-volt, 3-phase, 60-cycle generator, direct-connected to *D*, which is a 10-kw., 110-volt exciter. *F* is a 75-hp., 900-r.p.m., synchronous motor, driving *G* which is an air compressor with a capacity of 425 cu.ft. of free air per minute. *M* is a diesel starting unit for starting the large diesel engine. *E* is the electrical switchboard. *H* and *H* are the storage tanks for diesel oil. *K* is the receiver for the air compressor. *J* and *J* are the two cement pumps, driven by 60-hp., 220-volt, alternating-current motors. *L* and *L* are the 5-hp. motors which drive the longitudinal conveyors on the deck, and *N* and *N* are the 5-hp. motors which drive the cross conveyors under the deck.

Fig. 3—Part of float showing delivery pipe to shore bins

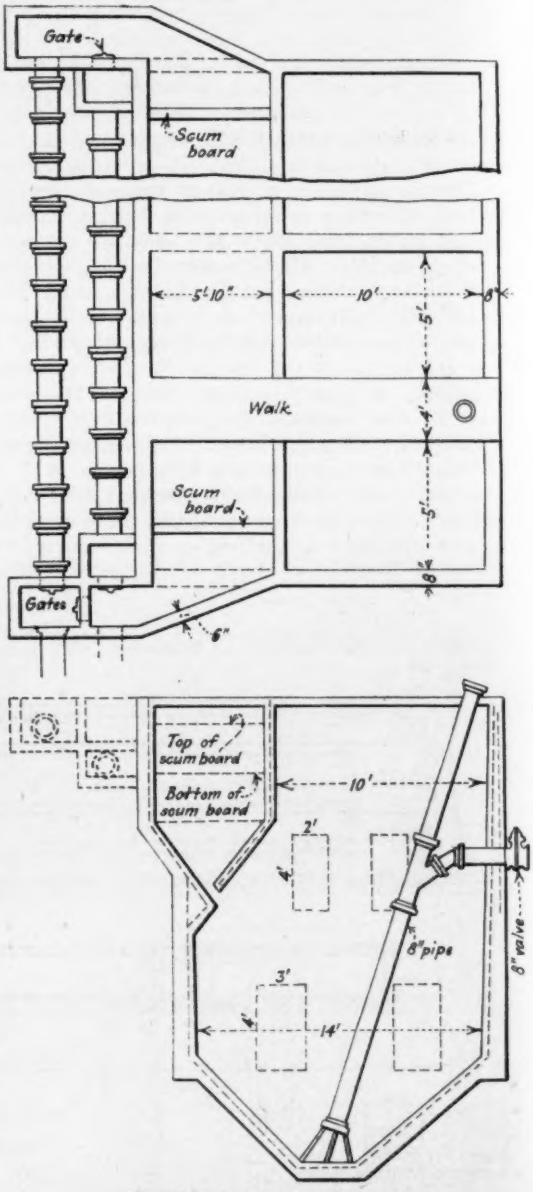
It is to be noted also that this float can be used to deliver cement direct to floating mixing plants, such as are used for dock and bridge-pier work.

Modified Form of Imhoff Tank Used in Four Oklahoma Towns

By FRANK B. KING
Civil Engineer, Oklahoma City, Okla.

INTRODUCTION of the Imhoff tank marked a long step forward in the treatment of sewage. Experience showed that modifications were necessary to get the best results. The first small openings from the sludge compartment, called "gas vents," choked with scum. To obviate this the vents were enlarged from time to time until the general practice now is to allow 15 to 20 per cent of the top area for this purpose.

It may be that where there is daily supervision or mechanical means are used to break up the scum, this is sufficient; but experience in Oklahoma, where much



Modified design of Imhoff tank
Small settling compartment on one side only with remainder of top of tank forming large gas vent and scum area.

Imhoff tank at Newkirk, Okla., showing modified form developed to meet local conditions

hot weather is experienced and where most installations are in small towns with little or no attention paid to operation, the area allowed gas vents—in reality, scum compartments—is not nearly enough. After being convinced of this by inspection of many tanks where poor results were obtained, the design shown herewith was adopted for Newkirk, a place of 2,500 population. After five years of use the tank is still giving excellent satisfaction. Three other tanks of the same character have been constructed, and no trouble has been experienced with any of them. They are at Bethany, Braman and Crescent, places of 1,500, 900 and 1,200 population.

In this style of tank about 60 per cent of the top is left for scum accumulation. The sludge bed is placed near the tank to allow scum to be thrown into it from the tank with a fork when excessive amounts interfere with the escape of gas.

The tank at Newkirk has three compartments while those at Bethany, Braman and Crescent have two.

Economies Seen in Increasing Use of Treated Ties

While treated-wood ties are considerably more economical than untreated ties, the latter would have sharp competition from substitute or composite ties if the treatment of wood ties had not reached its present extensive and successful use. In support of this view the figures in the accompanying table were presented by C. C. Cook, maintenance engineer of the Baltimore & Ohio Railroad, at the recent annual convention of the National Association of Railroad Tie Producers. An abstract of Mr. Cook's paper is given below. —Editor.

PRESERVATION of timber is essential to the continuance of wood as the one superior article for railroad ties. That preservation, too, must be of a superior kind. The facts noted by the accompanying table leave small margin for inferior treatments. When considering the difficulty of securing ten years' life from untreated timber now available and the advantage of long life of ties due to non-disturbance of the track surface, it will be seen that the composite tie, though not threatening the treated-wood tie, has every probability of displacing the untreated tie.

The first report of the total number of ties used by class I carriers appears in the Interstate Commerce Commission records for 1917. If ten years be taken as a fair figure for the life of untreated ties, it is apparent that it was approximately only the treated ties used prior to 1907 that would result in reducing the 1917 renewals. These ties did not represent any considerable proportion of the total renewals of those earlier years. It may be said, then, that the renewal figures for 1917 were approximately representative of the demands of the untreated-tie situation.

A high point in replacements was reached in 1920 and again in 1922, as shown by the table. Probably by the time this latter year was reached, the former installations of treated ties were making themselves felt. At any rate, it evidently marks the peak of tie requirements. In addition, 7,210,117 ties were laid in additional tracks, new lines and betterments during 1928, a figure which, despite the cessation of construction of additional road mileage in recent years, is maintained by internal development and the strengthening of existing tracks. The portent of these figures is that in 1917 the replacements averaged 214 ties per mile operated. In 1928, when the use of treated ties had become quite general and large decreases in renewals could reasonably have been expected, replacements averaged 192 per mile, a decrease of 10 per cent.

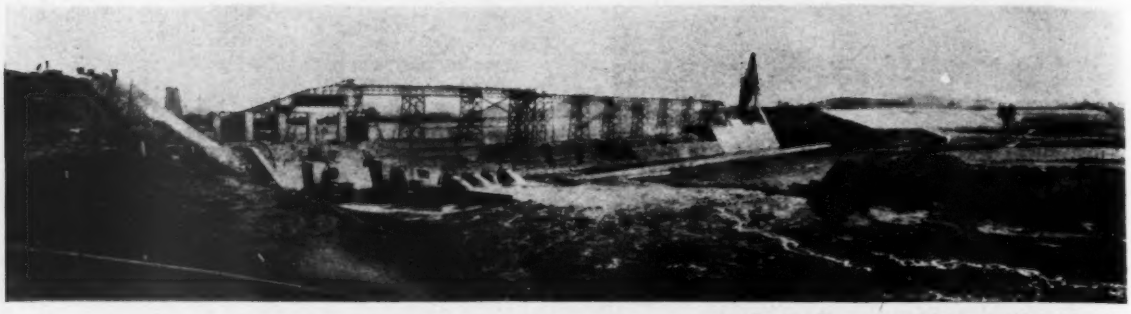
ECONOMIES IN TIE RENEWALS

	Life Years	First Cost	Capitalized Cost
Untreated tie	10	$1.50	$3.89
Treated tie	22	1.80	2.74
Composite tie	30	3.00	3.90
	1917	1922	1928
Total tie renewals	79,070,201	86,641,834	72,390,941
Total miles, all tracks	368,683	382,143	403,516
Renewals per mile	214	227	192

Complete records of renewals in untreated and treated ties on the Baltimore & Ohio Railroad have been tabulated since 1901. Analyses of these, supplemented by records on sections of experimental tracks, provide for accurate determination of average life. A curve of renewals giving the percentage of renewals in relation to per cent of average life expired enables a forecast to be made of the requirements for many years in advance. The accuracy of the forecasting is attested by the fact that the record permitted the forecast of renewals for the year 1915 and each year since. Including 1929, the total renewals forecasted were 34,047,792; the actual renewals were 34,643,568, a variation of less than 2 per cent between the estimate and the actual requirements.

The average renewal for 1917 was 240 per mile. For 1929 it was 152 per mile. The year 1934 should see the minimum requirement, 124 per mile. Thereafter, there will be successive cycles of increases and decreases, with a maximum of 170 per mile and a minimum of 124 per mile, until an average approximating 145 per mile per year will be reached and maintained as long as the present system is in effect.

During the first five years after another railroad began the use of treated ties, 1911 to 1915, inclusive, and before benefits from their service were derived, the average renewal per mile was 220. During the last ten years the renewals have averaged but 90 per mile, and in 1929 they were 54 per mile. The thorough treatment and the rapid displacement of untreated with treated ties will hold the renewals for the next five years to an average of around 50 per mile. Then the inevitable cycles of increases and decreases will carry the figure successively above and below 100 per mile, which will be about their average renewal, based on their average life expectancy of 30 years.



Hume dam across Murray River, Australia

Public Works Construction in Australia

Large undertakings include the Sydney Harbor bridge, the Murray River project, the federal capital at Canberra and numerous municipal works

By HAROLD E. BABBITT
Professor of Sanitary Engineering, University of Illinois

THE TWO Australian states of New South Wales and Victoria hold more than one-half of the continent's population, and more than one-third of the entire population is located in Sydney and Melbourne, the two capital cities, respectively, of these states. This concentration of population results in the location of the greatest engineering works in the southeastern portion of the continent. Among the great projects under construction in this district are the Sydney Harbor bridge, the underground railroad in Sydney, the Murray River project, the federal capital at Canberra and various waterworks and sewerage projects in Sydney and Melbourne. It should be noted that nearly all large engineering construction is being done on governmental projects.

Sydney Harbor Bridge

The construction of the Sydney Harbor bridge was described in *Engineering News-Record*, April 5, 1928, p. 538, and Oct. 23, 1930, p. 646. It is expected that the bridge will be opened to traffic in 1931. The underground railroad will probably be completed at the same time, so that the plans for the improvement of the city's traffic will mature as a unit. The construction of the underground railway was described in *Engineering News-Record*, Aug. 25, 1927, p. 310.

The Murray River is the largest river on the continent. It has a drainage area of about 414,000 square miles, of which about 256,000 square miles is in so arid a climate as to make no effective contribution to the flow of the stream. The river is usually navigable for almost 1,400 miles during about eight months of the year, but in dry years this period may be reduced to one month and in wet years extended to cover the entire year. The project for the control of the river to improve navigation, to supply water for irrigation and to generate electrical power has been under consideration for many years. Because of the difficulty of allocating the water among the three states of New South Wales, Victoria and South Australia it was necessary for the commonwealth to act in legalizing the project.

The River Murray waters act was passed by the commonwealth on Jan. 31, 1917. The administration of the act is vested in the River Murray Commission, which consists of one member from each of the three states, and a president who represents the commonwealth. The cost of the work is being shared by the three states and by the commonwealth. Responsibility for the construction of the various works is placed in the hands of the different states in which the particular structure lies. Where a structure lies in more than one state, as in the case of the Hume dam, different portions may be constructed by each state. The entire project includes provision for storage on the upper Murray with a dam near Albury, provision for storage at Lake Victoria, construction of 26 dams and locks on the Murray and nine dams and locks on various tributaries. The total cost of the work was estimated in 1917 to be about $24,000,000. Increasing costs and changes in plan have materially increased the estimated cost. Early in 1930 the progress on the work included the completion of most of the locks on the lower Murray in south Australia and the completion of some on the upper Murray. Work is under way on most of the remaining uncompleted locks on the main river, and the Hume dam and reservoir for storage on the upper Murray are more than 50 per cent completed.

The Hume Dam and Reservoir

The Hume dam and reservoir project involves the construction of a dam across the Murray River just above the city of Albury. As the river forms the boundary between New South Wales and Victoria at the location of the dam, portions of the dam and reservoir will be in different states. The design of the dam lends itself to an easy division of work between the two authorities. New South Wales will erect all of the concrete portion of the works except the core wall and the paving slabs for the earth section of the dam and it will place also a small amount of earthwork on the New South Wales side of the river. Victoria will place the earthwork of the dam and necessary concrete appurtenances thereto.

Beginning at the north or New South Wales end of the dam there will be an earthen embankment 430 ft. 6 in. long, terminating in a concrete wall called the north wing wall. The adjoining section of the dam is of con-

Bethanga bridge, an important crossing made necessary by the construction at Hume reservoir

crete and contains the sluice gates. This section is 284 ft. 3 in. long. The next section is the concrete spillway section, which is 720 ft. long, terminating in the south wing wall. All of that part of the dam north of the south wing wall is to be constructed by New South Wales authorities. South of this wing wall is an earth embankment 3,827 ft. long which is to be constructed by the Victoria authorities. The total length of the dam is 5,300 ft.; its greatest height 200 ft. It involves the placing of 3,893,000 cu.yd. of earthwork and 532,900 cu.yd. of concrete. The dam is designed to allow a head of 9 ft. of water over the spillway and an additional freeboard of 7 ft. to the top of the earth section. The normal flow through the dam will be regulated by seven needle valves, each 7 ft. 6 in. in diameter.

The dam will create a lake 50 miles long with an area of 69 square miles, containing 2,000,000 acre-ft. of water, which will permit an output of 263,000 acre-ft. per month during the irrigation season from August to April, inclusive. The creation of the reservoir will necessitate highway and railroad relocations, including the erection of a long through-truss highway bridge. This bridge, known as the Bethanga bridge, consists of nine trusses each 268 ft. 3 in. long, or a total length of 2,412 ft. The spans are supported on eight concrete piers which are slightly more than 100 ft. high. The foundation work and piers will be erected by Victoria, and New South Wales will place the superstructure. The work has progressed so that in January, 1930, all of the piers had been erected, seven of the trusses were in place, and the highway approaches were nearing completion. No work has been done on the relocation of the railroad, as it is at such an elevation as to be above water until the final height of the dam is reached. It is expected that the dam will be constructed to greater heights only as future irrigation needs demand. Provision is being made for the erection of a hydro-electric plant at the dam, but its construction is not yet under way.

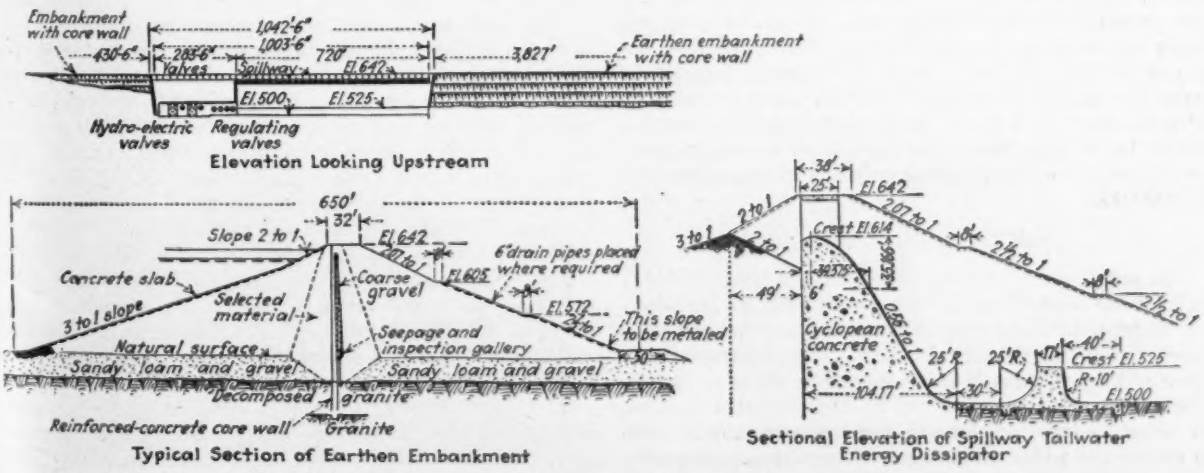
The provision for the drainage of the downstream side of the core wall is an interesting feature of the dam. A layer of coarse gravel is placed against the downstream side of the core wall and is supported on the roof of a seepage and inspection gallery which is incorporated as an integral part of the core wall and which extends the full length of the earth section of the dam. Leakage coming through the core wall will fall through the coarse gravel and will enter the inspection gallery through holes in the roof.

Canberra, the Capital City

Canberra, the federal capital of Australia, is an example of a bold attempt to create a large and beautiful city where none had previously existed, in a locality far removed from other centers of population and remote from transportation facilities. The site of the city is located in the southeastern part of Australia, 75 miles from the seacoast, 204 miles southwest of Sydney and 429 miles north of Melbourne. The surrounding country is beautiful but is not suitable for intensive agricultural purposes and there is little other than the activities of the government to attract population to the city. Transportation is almost entirely furnished to the city by a branch of the main line of the railroad, 65 miles long, between Sydney and Melbourne.

The seat of the commonwealth government of Australia was established at Canberra by the requirements of the commonwealth constitution act of 1900, and the present site was fixed in 1909 when the government of New South Wales ceded the necessary territory to the commonwealth. A world-wide competition for the plan of the city was conducted in 1912, the winning plan being submitted by W. B. Griffin, of Chicago. Work was commenced on the construction of the city on March 12, 1913. Parliament and other buildings were officially opened in 1928 and the seat of the government was officially transferred from Melbourne.

The creation of the city has involved the construction



Hume dam, elevation and cross-sections of the principal parts of the structure

by the government of all of the ordinary public works required by a municipality, such as water-works, sewers, paving, etc., and also the erection of residences and public buildings, and the construction of a railroad and other public utilities. The general procedure has been to construct permanent works, such as water-works and sewers, for a population of 40,000 and to construct such facilities as housing and paving to keep pace with the growing population. The population of the city in June, 1929, was 6,878. At that time the water-supply and sewer system for 40,000 people or more had been completed, about 80 miles of streets were finished and approximately 1,200 houses had been erected. All of the requisite public buildings have been completed, including buildings for such semi-public purposes as hotels and hospitals, and some small industries such as a steam laundry, garage, and ice plant. It is intended that all of the public buildings now erected be of a temporary nature. Work is now progressing on the first permanent public building. It will be used to house the Institute of Anatomy and a collection of valuable specimens of Australian fauna.

The total cash expenditure for the creation of the city up to July, 1929, was about $53,000,000. Of this amount $15,000,000 had been expended on "engineering," which included the usual public works of water supply, sewerage and public roads. The per capita cost of approximately $2,200 for such public works may present an unfair measure of the magnitude of the works completed to date compared with the present population. The average per capita cost of $720 for existing residences indicates more clearly how such construction is keeping pace with the population.

The appearance of the city is strange and striking, with great distances between settled districts; wide paved streets, well lighted, with but few residences; lines of young trees outlining curved roadways; pleasing architectural treatment of residences and public buildings; and an atmosphere of good taste and cleanliness. To one not considering the cost and who is convinced of the city's future splendor, the location, existence and appearance of the city are a delight. From the same viewpoint the efforts of the architects and engineers responsible for the creation and erection of existing structures are to be commended. The Australian taxpayer, however, is much inclined to look only at the expenditure of $53,000,000.

Melbourne Water Supply

The public water supply of Melbourne is obtained from uninhabited watersheds by the construction of impounding reservoirs. Four reservoirs are in existence and hold about 12 billion gallons of water. The construction of three additional dams is contemplated in the near future. The most remote reservoir will be 80 miles from the city. In order to increase the available storage capacity and to secure the added advantage of large storage capacity relatively near the city, one of the two large dams is now under construction. It is 25 miles from Melbourne. The construction of this dam across the Sylvan Valley will form a storage reservoir with a capacity of 8,800 million gallons. The reservoir will be fed principally by aqueducts from impounding reservoirs at higher elevations, as the watershed of the Sylvan Valley is relatively small.

Unusual Earth Dam Construction

Sylvan Dam No. 1, now under construction, is an earth embankment with a concrete core wall, 2,060 ft. long and more than 100 ft. high at its highest point. The embankment will contain 1,200,000 cu.yd. of earth. The upstream face of the dam will be paved with stone blocks, and the downstream face will be sodded and will be provided with berms 20 to 25 ft. apart vertically. The core wall is the principal detail of interest because of the provisions made for drainage. The downstream portion of the core wall is hollow, being formed of hollow vertical cylindrical wells 3 ft. in diameter on approximately 3½-ft. centers, extending vertically from the top of the wall to within 2 or 3 ft. of the roof of an inspection tunnel. The bottoms of these wells drain independently into the inspection tunnel through small drain pipes. The minimum thickness of concrete between the downstream face of the core wall and the inside of the cylinders, or wells, is about 6 in.

Sylvan dam, built to provide added water storage at Melbourne
Note the cylinders in the downstream side of the core wall.

The inspection tunnel is an integral part of the core wall and is placed slightly higher than the natural streambed so as to drain by gravity into the stream below the dam. No expansion joints are provided in the construction of the core wall, as it is expected that such cracks as appear will occur through the thinnest part of the wall of the hollow cylinders. Leakage can be detected at any point in the dam by inspection of the interior of the cylinders and proper remedies applied. The construction of the hollow cylinders offers little difficulty, as a sliding interior form is used which is raised as construction advances. The construction of such a core wall obviates the difficulty of placing a thin vertical layer of gravel and provides a strong impervious material against which the clay embankment can be packed.

The water supply of Sydney, like that of Melbourne, is obtained from a series of impounding reservoirs constructed on uninhabited watersheds remote from the city. All the reservoirs ultimately contemplated have not been

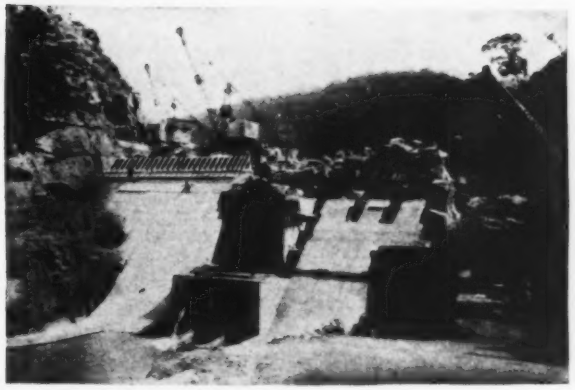
completed, present activities being concentrated on the construction of the Nepean Dam. This is a concrete dam with cyclopean masonry. It has a gravity section but is built curved in plan with a radius of 1,200 ft. Some details of the dam are listed in the accompanying table.

DATA ON NEPEAN DAM

Catchment area, sq.mi.	123
Storage capacity, million gal.	22,625
Maximum depth water, ft.	225
Full supply level	1,051
Freeboard, ft.	17
Maximum width of wall, ft.	215
Length at crest, ft.	700
Maximum flood discharge, sec.-ft.	92,800
Surface area (approximate), acres	900
Safe draft, m.g.d.	25
Maximum height of wall, ft.	268
Crest level	1,068
Foundation level	822
Width at crest, ft.	20
Volume of concrete, cu.yd.	342,300
Cost	$7,775,000

The design and the method of construction are similar to those used for dams recently completed. In describing the construction of the Avon Dam, the department of public works states: "The geological formation of the area is of particular interest as bearing upon the form of construction adopted for the dams. It consists of a sedimentary rock of the Triassic period, commonly known as the Hawkesbury sandstone. It occurs in extremely uniform horizontal beds 2 to 20 ft. in depth, without sign of flaw or fracture, interspersed by narrow bands of shales, grit and conglomerates. The stone is readily quarried from these ledges with low explosives, such as gunpowder, and with explosives alone may be cut into rough rectangular blocks of any practicable shape and size. It may be further divided inexpensively into smaller sizes and dressed by the use of hand tools and machinery. It has a pleasing appearance and is largely used as a building stone in Sydney, the cost of building stone in position being little more than twice that of brickwork. The relative ease in quarrying large rectangular blocks leads to the use in dam construction of a cyclopean masonry. It would be possible to dress the stones to accurate dimensions and bed and joint them in cement mortar and so produce a very fine class of random ashlar masonry, but to do so would involve a large amount of highly paid labor, a reduction in the size of the blocks, and a great expenditure of time to cut the blocks to fit. It is found more economical to use the stone in irregular blocks bedded on and packed with sandstone concrete, cement mortar being used only where necessary. Excellent concrete can be made with Hawkesbury sandstone crushed to 2½-in. gage, while by further crushing a good sand is produced. Concrete made from these materials has been under observation and test for many years and

Construction camp at Nepean Dam



Nepean Dam, Sydney

a breaking load of 120 tons [long] per square foot in 6-in. cubes of a 1:2½:5 mixture six months old is a fair average of observations."

A feature of the construction of these dams is the excellence of the camps provided for the construction organization. As the dams are located in uninhabited territory, the provision of good camps was necessary. At the Nepean Dam four and five room cottages have been built for the married men and good barracks for the single men. The village streets are metaled and have concrete curbs and gutters. All sewage is filtered. Special care is taken of the health of the community, a resident medical officer being stationed on the work. Shower baths and recreation rooms are furnished in connection with the single men's barracks, and public schools and public recreation rooms are also provided.

Sewer Construction at Sydney

The construction of the northern suburbs ocean outfall sewer, which was commenced in 1922, is nearing completion. Until this sewer is put into service, the sewage, where sewerage facilities exist, is treated in septic tanks or by the activated-sludge process, the effluent being discharged into Sydney harbor. The new outfall sewer will have a length of 20 miles from Parramatta to Blue Fish Point, north of Manly, where the sewer will discharge into the ocean. The sewer is designed to deal with sewage on the separate system on the basis of a future population of 1,125,000 on the area drained. The assumed rate is 94 gal. per capita per day, the maximum flow provided for being 291 sec.-ft., corresponding to a discharge of 42 per cent of the total daily flow in six hours. The sewer, which is mostly in tunnel through sandstone is, at the outfall end, 13 ft. 9 in. by 8 ft. 9 in. on a gradient of 1:3,100. The cost of the work, including two branch intercepting sewers having together a length of about 12 miles, is estimated to be $14,000,000. The construction of the middle harbor siphon, a particularly interesting piece of work, has been described in *Engineering* (London), Vol. 121, pp. 128 and 140.

The construction of the Lane Cove siphon and of the Camellia pumping station is nearing completion.

When the amount and diversity of work now under construction in Australia are compared with the population of the commonwealth, which is under 7,000,000, the initiative of the Australian people and the boldness of their engineers in the construction of public works can be appreciated. So many courtesies were received while gathering the information presented here that thanks can be expressed only in general to the many hosts.

ENGINEERING LITERATURE

A Monthly Review of Books and a Listing of New Publications

Practically a New Book on Hydraulics

REVIEWED BY JOHN H. GREGORY

Consulting Engineer, Professor of Civil and Sanitary Engineering, Johns Hopkins University, Baltimore, Md.

HYDRAULICS: For Engineers and Engineering Students—By Frederick Charles Lea, D.Sc. (Engineering, London), M.Inst. C.E.; M.I.Mech.E., Professor of Mechanical Engineering in the University of Sheffield. New York: Longmans Green & Co. London: Edward Arnold & Co. Cloth; 6x9 in.; pp. 775; halftones, tables and many line cuts. $7.50.

PROFESSOR LEA'S "Hydraulics" is designed, as the title says, for both engineers and engineering students. It covers a wide field, much more than is given in the ordinary course in hydraulics in engineering schools in the United States. The first edition appeared in 1908, and the fifth in 1930. The second edition was reprinted, and the third and fourth editions each reprinted twice. Such an accomplishment, alone, speaks well for a book, and the author should feel well satisfied that he has produced a good book, and one that must have been kept up to date. The present edition is practically a new book as compared with the first edition, reviewed in *Engineering News*, May 14, 1908, p. 541.

The first seven chapters deal with fluids at rest, floating bodies, fluids in motion, flow of water through orifices and over weirs, flow through pipes, flow in open channels, and gaging the flow of water. Two chapters then deal with impact of water on vanes, and waterwheels and turbines; two with centrifugal pumps, and reciprocating pumps; one with hydraulic machines; the last three with resistance to the motion of bodies in water, stream line motion, and dynamical similarity.

At the end of each chapter, except the last two, problems are given, there being all told 268 such problems, and at the end of the book answers are given to many of them. It is obvious from the nature of some of the problems why answers to these are not given; but it is not clear why answers to some of the other problems are omitted.

From the standpoint of the writer, some of the chapters are too long; for example, 87 pp. are devoted to the chapter on flow of water through orifices and over weirs. That the author may have had a somewhat similar thought is evidenced by the fact that the problems on the flow of water through orifices are given in the middle of the chapter immediately following the text treating of that subject, whereas the problems on the flow of water over weirs are given at the end of the chapter. Again, 110 pp. are devoted to flow through pipes, and 150 pp. to waterwheels and turbines. Too long chapters detract from the readability and easy use of a book. On the other hand, too many chapters may be a nuisance. A happy medium should be the end sought.

The book is a good one, and the student or engineer who has mastered the text should be well grounded in theoretical hydraulics. But as with some other books on hydraulics with which the writer is familiar, when an American engineer comes to solve the everyday problems of most hydraulic engineers he will have to accustom himself to somewhat different nomenclature and symbols and refer to handbooks and practical treatises on hydraulics for coefficients and many formulas in common use in this country. Notwithstanding this, the book is one which should be on the shelf of every engineering library, and the practicing engineer can well afford to add the book to his library, as one of its excellent features is the presentation of special problems the solutions of which are not ordinarily found in textbooks on hydraulics.

The book is well printed and bound, and the cuts, in general, though not uniform in style, are well executed. A 13-p. index is included. The writer regrets, however, that immediately following the table of contents the list of illustrations and also the list of tables has been omitted. To the user of a book, lists of tables and illustrations are often of great convenience.

Builders of the Panama Canal

GOETHALS, GENIUS OF THE PANAMA CANAL—By Joseph Bucklin Bishop and Farnham Bishop. New York and London: Harper & Bros. Cloth; 7x10 in.; 11 illustrations. $5.

WILLIAM L. SIBERT: The Army Engineer. Major General, Retired; Builder Gatun Locks and Dam, Panama Canal, etc.; Chairman of Board to Determine Economic and Engineering Feasibility of the Boulder Dam Project—By Edward B. Clark, Colonel, United States Army, Res. Philadelphia: Dorrance & Co., Inc. Cloth; 6x8 in.; pp. 206; 16 halftones. $2.50.

ALTHOUGH both Goethals and Sibert did enough else in many lines to make them outstanding figures in the annals of civil and military engineering, they are and will always be remembered for their parts as builders of the Panama Canal—Goethals as chief engineer after the work had been well started by his two predecessors, Wallace and Stevens, and Sibert as builder of the Gatun dam and locks.

The senior author of the life of Goethals was secretary of the Isthmian Canal Commission and an intimate friend of Goethals and Theodore Roosevelt. Unfortunately, the senior author was cut off from the biography after the first few chapters were written, just after, at the ripe age of 80, he had followed the Goethals' caisson to the grave. The biography has been ably carried to its conclusion by the son of J. B. Bishop, who had access to important state papers.

Naturally the larger part of the book on Goethals is devoted to the Panama Canal. Sufficient attention is given to Goethals' ancestry—on record for a thousand years—his early life, his career at West Point, his work as an army engineer before going to Panama, his important activities during the late war and his later activities in semi-private and private life. If overmuch space is given to any one subject, to most readers it will be the controversy over wooden ships during the war. Another controversy dealt with relates to sanitation. The authors hold that, in the interest of economy, Goethals was justified in taking part of mosquito control work away from Gorgas and putting it under engineers. The words of

both men on this subject are quoted, and on their face Goethals has the better of it, but he had the last words, they having been written after the death of Gorgas.

In the portion of the book dealing with Goethals' consulting work, the biographer shows a strong feeling that attempts were made, and resisted, to exploit Goethals' great reputation for commercial ends.

On the delicate subject of turning the canal over to army engineers after two engineers in civil life had resigned, the biography is fair. Besides giving credit for the preliminary work done by Goethals' predecessors, work which gave him a running start toward making the dirt fly, the book makes clear how badly hampered everybody was under the initial system of divided control. Goethals was quick to see and as quick as could be expected to get rid of this divided control. Yet had he not been a genius for organization and a giant of a worker, even the military system of which he was the head would not have enabled him to master his job so completely and efficiently.

Coming now to Clark's Sibert, it may be noted first of all that whereas the Goethals' biography has as its sub-title "Genius of the Panama Canal," the Sibert sub-title is "The Army Engineer." As such Sibert had a notable career, both on canal and harbor work and in military activities. Aside from the Panama work Sibert acted a leading part on the improvement of navigation in the Ohio River by the federal government and on an ocean terminal at Mobile for the State of Alabama. The American Red Cross enlisted him in services on flood-relief measures in China. Quite recently he was chairman of a federal board on the Boulder Dam project, Colorado River. All these and other activities of Sibert are well told in the Clark biography—for which a brief and appreciable foreword has been written by Major-Gen. Lytle Brown, Chief of Engineers, U. S. Army.

A significant illustration of the solidarity of the Goethals' organization at Panama is afforded by the revelation in this book of strong differences of opinion between Goethals and Sibert on lock design and location. According to the biographer, Sibert was so far right in this case as to mean hundreds of thousands of dollars in first cost and in operating cost arising from building locks at two sites instead of one. Had this difference of opinion been made public, Sibert's biographer urges, it would have fed fuel to the flames of controversy over the canal at Washington and in the press of the country.

Both these biographies make a strong appeal to the interest of engineers, contractors and the general reader. This arises from the men whose services are outlined, the activities themselves and the interesting way in which the lives are written.

Now that we have good biographies of Goethals and Sibert, and also of Gorgas, it is to be hoped that equally satisfactory attention will soon be given to the other chief lieutenants associated with Goethals—Gaillard, for whom the great Culebra cut was renamed; Hodges, designer of locks, dams and regulating works, called the "great artist in steel" by the Goethals biographers; and Rousseau, in charge of shops, municipal works, terminals, dry docks and coaling station. Presumably these additional lives will be written in time, although proper biographical attention to worthy American engineers is still sadly lacking.

British Research in Reinforced Concrete

STUDIES IN REINFORCED CONCRETE: I, Bond Resistance; II, Shrinkage Stresses; III, Creep or Flow of Concrete Under Load—By W. H. Glanville, D.Sc., Ph.D., Assoc.M.Inst.C.E. [Technical Papers Nos. 10, 11 and 12, Building Research, British Department of Scientific and Industrial Research.] Paper; 6x10 in.; pp. 37, 49 and 39; line cuts and halftones. 9d. for No. 10 and 1s. each for Nos. 11 and 12, from His Majesty's Stationery Office, London, or 30c. and 35c. from British Library of Information, 5 East 45th St., New York City.

1. Bond Resistance

THE first of these three papers describes a special extensometer which permits the measurement of the distribution of bond stress, including the initial stresses induced by shrinkage. The results obtained with this instrument were in agreement with general theory, except that the ratio between bond stress at first slip and maximum bond stress was found to be much higher than in Abrams' investigations. It is also shown that the bond with aluminous cement concrete does not show any appreciable decrease with large slips up to ½ in. or more, as it does with portland cement concrete. Also, the high early strength of aluminous cement is accompanied by high bond strength, which tends to increase with age. The rate of growth in bond stress of rapid-hardening portland cement is not appreciably greater than that of normal portland cement.

II. Shrinkage Stresses

In the second paper a formula is developed for the calculation of the steel strain due to shrinkage of the concrete in a symmetrically reinforced member. Differences are shown to exist between the original stresses induced by shrinkage in aluminous and portland cement concrete, but after about twelve months there is little to choose between them or between normal portland and high-early-strength portland. Also, when stored in water portland cement concrete swells practically continuously, while aluminous cement concrete shrinks at first, inducing steel stresses up to about 1,000 lb. per sq.in., but subsequently swells by a greater amount than the portland cement concrete. Stresses induced by swelling are shown to be lower than those accompanying shrinkage and are small enough to be ignored. Shrinkage stresses were found not to vary greatly with normal variation between mixes. Water content is also shown not to have a great influence.

III. Flow of Concrete

A series of tests on both plain and reinforced concrete is described in the third paper. In plain concrete the creep is found to be practically proportional to the applied stress within the range of working stresses, the magnitude of creep depending on the type of cement used, the more rapid the hardening of the cement the smaller the creep of the concrete when stored in air. Creep was considerably lower for specimens of portland cement concrete maintained wet than for similar specimens stored in air. Aluminous cement concrete showed the reverse effect. The effect of creep in plain concrete may be allowed for by considering the value of the modulus of elasticity as reduced, but for reinforced-concrete calculations the reduced modulus of elasticity can be used only as a rough guide. What are believed to be exact formulas for columns are developed in the paper. The influence of the creep of the steel under load is discussed, and it is pointed out that this factor

will in all cases, where sufficient creep occurs in the concrete, decide the limiting stress that can be reached in the steel.

Two Texts on Structural Design

STRUCTURAL THEORY AND DESIGN: Theory — By Hale Sutherland, A.B., S.B., M.Am.Soc.C.E., and Harry Lake Bowman, S.M., M.Am.Soc.C.E. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.: pp. 318; tables and many line cuts. $3.50.

DESIGN OF STEEL STRUCTURES—By Leonard Church Urquhart, Professor in Charge of Structural Engineering, and Charles Edward O'Rourke, Assistant Professor of Structural Engineering, Cornell University. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 448; halftones, tables and many line cuts. $5.

THE above noted books on structural design, one introducing the reader to the basic principles of theory, the other concerned with the actual designing of structures, principally bridges, join an already large library on the subject. Both, however, record departures from previous texts, departures which reflect modern thinking in the teaching of structural design.

Sutherland and Bowman's "Structural Theory" covers the elementary principles of design, requiring of the reader only a knowledge of applied mechanics and physics. A characteristic that will at once impress the reader is the use of many unusual structures for illustrative purposes. The authors defend the use of these unconventional designs on the basis of desire to simplify arithmetical labor and to compel application of principle. After a short review of reactions, stresses and force systems and a very short chapter on roof trusses, bridge trusses are treated in considerable detail. The use of influence lines is introduced in one of the early chapters. A feature of the book is that many of the methods of stress calculation, unknown except by name to the engineering student of a few years ago, are described in enough detail to make them familiar. The authors make a special point of reviewing the origin of the more important methods, an interesting innovation. In a chapter on slope and deflection the method of elastic weights, the method of moment areas, the rarely used but important bar-chain method of elastic weights, the Williot-Mohr diagram for determining truss joint displacements and Maxwell's law of reciprocal deflections are all described and illustrated. Another innovation is the treatment of rigid frames in an elementary text of this character, in which such methods of calculation appear as the theorem of three moments, method of least work, method of slope deflection and method of moment distribution, recently introduced by Prof. Hardy Cross, of the University of Illinois. Wind stresses in tall buildings also receive consideration; several of the well-known methods of design for horizontal forces are presented, and an approximate method developed by one of the authors is also treated in some detail.

Urquhart and O'Rourke's "Design of Steel Structures" takes up the subject where Sutherland and Bowman leave off. It was, in fact, written to follow another text by the authors first named, entitled "Stresses in Simple Structures," which is comparable to the text reviewed above. This latest book is a particularly practical discussion of design procedure. It has less the appearance of a textbook than usual, in that no problems are given. The college course in which it can be used, therefore, is not rigidly defined by the nature of the book, a characteristic which will probably be welcome to many professors. The first five chapters are in a measure introductory, discussing the various types of members used in structures, riveted joint theory and design, and describing roof trusses and plate-girder bridges. Each of the next six chapters is devoted to a complete design of a particular bridge. For anyone desiring to review the subject of bridge design procedure or for students who are in a measure teaching themselves, the book should prove ideal. In its final chapter a modern note is struck in presenting a brief discussion of welding as applied to steel structures. The appendices include the various standard specifications for buildings and bridges and one for structural welding.

British Book on Sewage Disposal

MODERN SEWAGE DISPOSAL AND HYGIENICS: Being a treatise on the subject of sewage disposal, with details of present-day practice outlining the basic laws relating thereto and the requirements of the ministry of health regarding works for the purification of sewage.—By S. H. Adams, Assoc.M.Inst. C.E. London: E. & F. N. Spon, Ltd. New York: Spon & Chamberlain. Cloth; 6x9 in.; pp. 473; tables, graphs and illustrations. 25s. net.

MR. ADAMS devotes most of his book to a review of the progress of sewage disposal from early days to the present time, with particular reference to treatment. A long opening chapter outlines sanitation and its lack through the dark ages and its slow rise during the first half of the nineteenth century. Interwoven with this story is that of deplorable living conditions through most of the centuries covered. A few pages are then given to the history and work of the British ministry of health. Then come chapters on sewage treatment in the order of their development, from land treatment to the activated-sludge process, and a long chapter on ministry of health requirements as to sewage treatment. A chronology of 18 pp.—600 B.C. to 1929—follows the general lines of the opening chapter. Although the author deals chiefly with British methods, he by no means ignores what has been done in America, Germany and France. As "founder and former owner of Adams Hydraulics, Ltd.," the author had had occasion to keep well posted on sewage practice over a long period. He has supplemented the knowledge thus gained with much patient reading and notetaking. As a result the book is both interesting and informing.

Valuation Principles, Methods and Data

APPRAISERS AND ASSESSORS MANUAL—By W. L. Prouty, Assoc.M.Am.Soc.C.E., member of Prouty Bros. Engineering Co., Denver; Clem W. Collins, C.P.A., Manager of Revenue and Assessor, City of Denver, member of Collins, Witting & Co., C.P.A.'s., Denver, Professor of Accounting, University of Denver; and Frank H. Prouty, M.Am.Soc.M.E., member of Prouty Bros. Engineering Co., Denver. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 500; many illustrations and tables. $5.

ENGINEERS, architects and others who have to do with the valuation of property for taxation or other purposes should welcome the comprehensive manual named above, as should owners of land, buildings and other property who wish to maintain a clear idea of the value of their holdings. It is written from the viewpoints of the engineer and the tax assessor. It abounds with data on almost every essential phase of valuation of land and

buildings. It is less detailed on other classes of personal property. After considering the principles of taxation, valuation and "scientific assessing," there are chapters on building and labor costs over a period of years, establishing a system of building appraisals, physical depreciation, obsolescence, and building cost methods. Next nine classes of buildings are taken up, and then building cost details, appraisal record systems and field appraisal methods. Land appraisal is given two chapters; industrial plants has one and motor vehicles another. There is a 5-p. bibliography and an index, the latter with entries by cities.

Useful Addition to the Who's Who Family

WHO'S WHO IN GOVERNMENT—Vol. I. New York: The Biographical Research Bureau, 460 West 34th St. Cloth; 8x10 in.; pp. 800; halftone frontispiece portrait of President Hoover. $10. Publishers state that "Subscribers will receive frequent supplements which will keep the book accurate and timely at no advance over the" price named.

THE latest addition to the rapidly growing list of useful Who's Who contains some 12,000 sketches of men and women holding elective or appointive offices in our federal, state, county and city governments. These are arranged alphabetically and are supplemented by a geographical index of 75 pp. Federal and state officials seem to be more completely covered than the others. Engineers of state boards of health seem to be omitted more often than given. City engineers seem to be few, even for cities of considerable size. Doubtless many of those omitted failed to give requested information. Notwithstanding these and presumably other omissions this addition to the Who's Who family will be useful to many.

Parks of 66 Counties

COUNTY PARKS: A Report of a Study of County Parks in the United States—Edited by George D. Butler. New York: Playground and Recreation Association of America. Cloth; 7x10 in.; illustrated. $2.

MANY will be surprised to learn that at least 66 counties in the United States now have park systems —quite distinct from city or state parks—with a total area of 100,000 acres. After tracing the growth of county park systems, this book presents in detail important statutes on the subject and takes up financing and administering park systems. Human uses and economic and social effects of county parks are discussed. There is a bibliography. Of two appendixes, one summarizes legislation and the other gives physical and financial data, both in tabular form. In compilation and comment the work is admirably done. The illustrations visualize important elements of park systems.

Technical Reading and Writing

SCIENCE AND THE SCIENTIFIC MIND—By Leo F. Saidla, Assistant Professor of English, Polytechnic Institute of Brooklyn, and Warren E. Gibbs, Instructor in English, Columbia University, and Lecturer in English, Polytechnic Institute of Brooklyn. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in. $3.

IN THE curriculum of engineering and other technical schools perhaps nothing has changed more in the last few decades than instruction in English composition. In at least one engineering school in the eighteen eighties freshmen were assigned successive periods in English history as themes for "essays." The resulting abstracts or more or less disguised extracts from such histories as could be found were turned in for the red ink decorations of the professor—a reverend gentleman in the arts department. In recent years our technical schools have their own instructors in English. These men aim to make their courses so interesting and practical as to attract rather than repel their students; particularly as to required and suggested reading.

"Science and the Scientific Mind" is one of the best of these latter-day attempts we have seen. It has a central theme that should appeal to the students in a technical school and afford them good material for reading as well as good subjects for exercises in writing. Essays and addresses by notable scientists who can both think and write clearly are grouped under six heads: science, the scientific mind, scientific motive, science and culture, the place of science in a liberal education, science and civilization, science and the future. Among the 22 men represented are R. A. Millikan, John Tyndall, Thomas H. Huxley, Nathaniel Shaler, Bertrand Russell, J. S. Haldane and Thorstein Veblen. A short, illuminating and interesting sketch precedes each of the essays. Of four appendixes, one deals with the structure of an essay, one gives topics for oral or written discussions or reports, one is a reading list and the last is a series of brief biographical sketches of the "various scientists, artists and statesmen" mentioned in the material reprinted.

The book seems admirably suited to its primary purpose as a school text and also to reading and rereading by engineers and other technical men and women in their post-school days. For both classes it will broaden the mind and give added ability in self-expression.

Publications Received

A PRICED CHECK LIST of publications of the U. S. Bureau of Standards on building materials, home building, home ownership, city planning, and zoning, may be obtained by writing to the bureau at Washington, D. C.

CAREERS FOR COLLEGE STUDENTS, Circulars 25 and 27, Office of Education, Washington, D. C., deal with electric and civil engineering respectively, and are by Walter J. Greenleaf, associate specialist in higher education. Besides outlining the work of engineers, both in college and in daily practice, there is a list of engineering schools, by states, with tuition fees and 1928 enrollments. Free on application to the office mentioned above.

THE PRESIDENT'S emergency committee for unemployment (Commerce Building, Washington, D. C.) has available for applicants two pamphlets which "seek to give a brief survey of what can be done and what is being done by industrial firms to shape a constructive course of action for the mutual benefit of themselves and their employees during times of economic depression": "An Outline of Industrial Policies and Practices in Time of Reduced Operation and Employment" and "A Survey of Unemployment Relief in Industry."

AN EXAMPLE of increasing public health work by counties is afforded by the seventh annual report of the board of health of Cattaraugus County, New York, devoted entirely to a condensation of "an appraisal of the health activities" of the country in 1929, in accordance with "the standards of the American Public Health Association." This appraisal is a part of a "survey" made early in 1930 by Prof. C.-E. A. Winslow and Ira V. Hiscock, professor and associate professor of public health in the Yale school of medicine. The appraisal covers the year 1929, but the entire study includes the period since 1923. The work was sponsored by the Milbank memorial fund. Among other things covered by the pamphlet (117 pp.) are sanitary engineering in the county, including water supply and typhoid fever and the Olean epidemic. A novel feature of the report deals briefly with salamanders as probable sources of B. coli in water supplies.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

ANALYTICAL CALCULATION OF COMPLICATED AIR-DUCT: Part I. The Method of Equivalent Orifices; Part II, The Method of Requalents—By P. N. Kamenev, Engineer. Stalino (Donbass) Ukraine S.S.R. Paper; 8x12 in.; pp. 54; line cuts and tables, including a large folding table. Address the author, as above. A larger monograph on this subject, in Russian, with 210 pp. of text and 26 tables is available at 9½ rubles.

The author states that he has improved upon "the special atlas of nomograms" which was "worked out by Eng. Dr. Blaess on the principles of a French Engineer Murgue" by substituting "two very convenient tables," to which he (Kamenev) has added "all tables necessary to determine fundamental values (such as final velocity, final diameter," etc.).

A.S.T.M. STANDARDS: Triennial Issue, 1930—I. Metals. II. Non-Metallic Materials. Philadelphia: American Society for Testing Materials, 1315 Spruce St. 2 vol.; 6x9 in.; pp. 1,000 and 1,214. Price: Cloth, $7.50 each or $14 for both; half calf leather, $9 each, or $17 for both.

A total of 430 adopted standards, of which 76 are for steel, 39 for cement, lime, concrete and aggregates, 48 for road materials, 36 for preservative coatings and 26 for waterproofing and roofing materials.

BÉTON ARMÉ—Par Victor Forestier, Ingénieur-Constructeur (A. et M.), M.Soc.Ing.C. de France. 4th edition, 1931. Paris: Dunod, 92 Rue Bonaparte (VI). Flexible; 4x6 in.; pp. 432; 262 illustrations. 20 francs in Paris; postpaid to foreign countries, 23.3 francs.

French annual handbook on reinforced concrete. Besides revision, has a new chapter of 6 pp. on the Planchers-Champignons system of reinforcing column-supported floors.

CONSTRUCTION JOINTS IN CONCRETE—Bonding New Concrete to Old—By Norman Davey, B.Sc., A.M.Inst.C.E. Special Report No. 16, British Department of Scientific and Industrial Research. Paper; 6x10 in.; pp. 72; illustrated. 2s. from H. M. Stationery Office, London, W.C. 2; 70c. from British Library of Information, 5 East 45th St., New York City.

CONTROL: A Pageant of Engineering Progress—Written and Directed by George Pierce Baker (Department of Drama, Yale University). New York: American Society of Mechanical Engineers, 29 West 39th St. Boards; cloth back; 6x8 in.; pp. 63; 10 illustrations. $1.35.

EMBRITTLEMENT IN BOILERS—A Report of an Investigation Conducted by the Engineering Experiment Station, University of Illinois, in Cooperation with the Utilities Research Commission—By Frederick G. Straub. A partial reprint of Illinois Engineering Experiment Station Bulletins 155 (1926) and 177 (1928). Urbana: University of Illinois. Paper; 6x9 in.; 65c.

DIE ENTWÄSSERUNG DER STADT HALLE—Herausgegeben von Magistrate der Stadt Halle. Düsseldorf: Fritz Lindner. Paper; 9x12 in.; pp. 78; halftones and line cuts.

FIELD INSPECTION OF CONCRETE PIPE CULVERTS—By R. W. Crum, Director, Highway Research Board, National Research Council. Paper; 6x9 in.; pp. 32; tables and illustrations. Free from Engineering Experiment Station, Ames, Iowa.

GRUNDWASSERABSENKUNG BEI FUNDIERUNGSARBEITEN—Von Dr.-Ing. Wilhelm Kyrieleis. In Zweiter Auflage Neubearbeitet von Dr.-Ing. Willy Sichardt. Berlin: Julius Springer. Paper; 6x10 in.; pp. 286; 152 line cuts and halftones. 21 marks in paper; 22½ marks bound.

HANDBUCH DER WASSERVERSORGUNG—By Prof. Erwin Gross. Munchen und Berlin: R. Oldenbourg. Cloth; 7x10 in.; pp. 485; 22 figures in the text. 22 marks.

LIGHT FRAME HOUSE CONSTRUCTION: Technical Information for the use of Apprentice and Journeyman Carpenters—Issued by the Board for Vocational Education in Cooperation with the National Committee on Wood Utilization, U. S. Department of Commerce. Paper; 6x9 in.; pp. 216; many illustrations. 40c. from Superintendent of Documents, Washington, D. C.

MITTEILUNGEN AUS DEN FORSCHUNGSANSTALTEN—Nurnberg: Gutehoffnungshütte. Paper; 8x12 in.; pp. 24; halftones, tables and line cuts.

A new research publication in the metal field, which is to be published at irregular intervals as available material requires. It will present by products of general public interest obtained in the industrial research of the Gutehoffnungshütte and its affiliated companies, comprising steel, casting, structural, machine and shipbuilding and wire works. This first issue contains three articles: Mattheis on copper-bearing steel for corrosion resistance, Junger on endurance tests with a magnetic vibration machine, and Klingenstein on effect of phosphorus in wear resistance of cast iron.

TORSIONAL EFFECT OF TRANSVERSE BENDING LOADS ON CHANNEL BEAMS—By Fred B. Seely, Professor, William J. Putnam, Assistant Professor, and William L. Schwalbe, Associate, in Theoretical and Applied Mechanics. Urbana, Ill.: University of Illinois. Paper; 6x9 in.; pp. 66; halftones, tables and line cuts. 35c.

Shows that loads must be applied in a plane parallel to but at a considerable distance back of the web to produce bending without twisting. Confirms the assumption that angle connections attached to the back of the web of a channel transfer the transverse load to the channel beam approximately in the plane which causes the beam to bend without twisting and thus develop its full bending resistance. Where the load is not so applied, the experiments developed an equation expressing the maximum value of the additional longitudinal stress caused by the twisting moment. This additional stress is considerable unless the channel is laterally restrained at a number of points. Where not restrained channel sections with thick webs are desirable.

WATER SOFTENING FOR THE HOME—By Lindon J. Murphy, Municipal Engineer, Engineering Extension Service, Iowa State College, Ames, Iowa. Paper; 6x9 in. pp. 18; illustrated.

LETTERS TO THE EDITOR

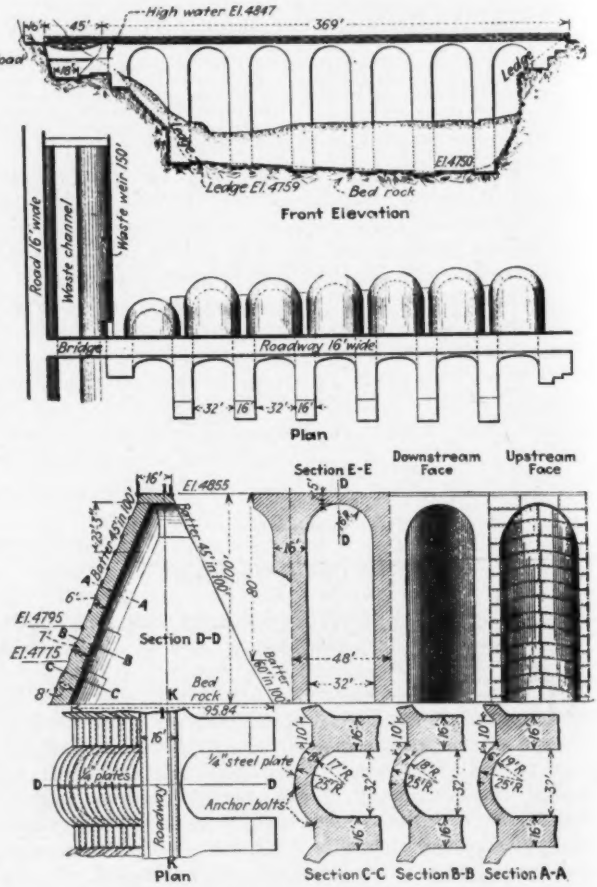
✦

Modified Design for Multiple-Arch Dams

Sir—The writer was much interested in the article on gravity dams by Fred A. Noetzli and the brief editorial comment on it in your issue of Dec. 4, 1930.

While in many locations the ordinary gravity dam will remain the most suitable form, I have long felt that in some cases a modified design can be used with a decided saving in the cost of the dam, without any detriment to the safety of the structure.

As long ago as 1897 I worked out a multiple-arch dam with mass concrete buttresses, similar to the plan shown in



Details of the proposed Pioneer Power dam

Mr. Noetzli's Fig. 7. This design was described in an article published by me in the *Trans.* Am.Soc.C.E., entitled "Power Plan, Pipe Line and Dam of Pioneer Electric Power Company, at Ogden, Utah." (Paper 815, Vol. 38, 1897, pp. 246-314.)

Although this dam was not built, owning to a change in the project, the details were quite carefully worked out. It will be noted in the accompanying illustration that the arches between the piers are nowhere less than 6 ft. in thickness.

After the design was completed bids were asked for from a number of experienced contractors. While the amounts differed, they were in every case considerably lower than the tenders for a solid masonry dam. The lowest bid was made by Christie & Lowe, of Chicago, well-known contractors. The saving was about 15 per cent over a standard masonry dam for the same location.

Nyack, N. Y.
Dec. 15, 1930.

HENRY GOLDMARK,
Consulting Engineer.

NEWS OF THE WEEK

N.Y. Port Authority Reports on Financing New Hudson Tunnel

IN A preliminary report to the governors and legislatures of New York and New Jersey, made public on Jan. 12, the Port of New York Authority declares the proposed midtown vehicular tunnel under the Hudson River to be feasible financially and physically. The proposed tunnel would extend from Ninth Ave. near 38th St., Manhattan, to Weehawken, N. J. The Port Authority urges the passage of the necessary enabling legislation in order that the tunnel may be completed by 1937.

A feature of the report is a recommendation that the entire matter of the interchange of vehicle traffic between the several parts of the port district be treated in a unified program which would include pooling all excess revenues from existing bridges and tunnels and the proposed tube. This, the report declares, would involve refunding the bonded debt on the Holland tunnel and return of about $25,800,000 each to the New York and New Jersey state treasuries.

The report proposes the following principles as the bases for a comprehensive development program:

Immediate authorization of the midtown Hudson vehicular tunnel and the development of studies to anticipate additional facilities as they may be required by traffic demands.

Placing the Port Authority in control of all fixed vehicular crossings, making possible economies in operation and standardization of practices and regulations.

Pooling of surplus revenues from the Holland tube, the new Hudson midtown tube and the four bridges now under Port Authority control. This practice, the report asserted, would lend additional security to all bondholders in Port Authority projects, strengthen the Port Authority credit and reduce the cost of future construction.

Public Works Prospects the Same as Last Week

The week's returns on *Engineering News-Record's* survey of public works construction totaled in 1929-30 caused very little revision of the figures published last week. The extended totals are given below:

1929	$2,800,000,000
1930	2,109,000,000
1931	3,439,000,000

Revised estimates will be published in subsequent issues based on more complete returns.

Local Sections of Am.Soc.C.E. Aid Employment Survey

In an effort to ascertain the reasons why some public and semi-public works projects throughout the country which have been authorized and financed are not being actively prosecuted, the President's emergency committee for employment, through the American Engineering Council, is using the local sections of the American Society of Civil Engineers as field agencies for the collection of original information. Questionnaires to bring out the desired data have been sent to all local sections and, in addition, to certain individuals in a position to know of conditions in parts of the country not covered by any local section of the society. Immediate return of the questionnaires is urgently requested, so that steps to speed up desirable construction can be initiated.

This work is being directed for the public and semi-public works section of the President's committee by J. Franklin Miller, an engineer by training. Gen. C. W. Kutz, U. S. Engineer Corps, retired, is the representative of the American Engineering Council.

San Diego Awards Sewer Plan Contract to the Only Bidder

DESPITE the adverse report of its manager of operations, Fred Lockwood, the council of the city of San Diego, Calif., on Jan. 2 entered into a contract with Frank W. Seifert, a former councilman who is not a civil engineer, providing that the latter shall furnish, for the sum of $18,000, complete plans, specifications and cost estimates for a city sewage-disposal system. As noted in our issue of Jan. 1, p. 42, Mr. Seifert submitted the only proposal received following a general call for bids published by the city (noted Dec. 11, 1930, p. 942). The contract provides that plans for the most efficient and economical system are to be approved by the manager of operations, and that R. F. Goudey, sanitary engineer, of Los Angeles, is to supervise its technical details. Should Mr. Goudey not be available, some other sanitary engineer of equal prominence is to be employed after his selection has been

NEW PENNSYLVANIA FREIGHT TERMINAL IN JERSEY CITY

Fairchild Aerial Photo

On Jan. 6 appropriate ceremonies marked the official opening of the new piers in Jersey City which will be operated in conjunction with the rail-to-keel terminal built by the Pennsylvania R.R. Co. and the Pennsylvania Dock & Warehouse Co. The facilities cover more than nine acres and five city blocks adjacent to the Jersey City Exchange Place station of the Pennsylvania R.R. and include the erection and operation by the Pennsylvania Dock & Warehouse Co. of two eight-story warehouses 300x320 ft. Another structural unit, also built by the warehouse company, is an eight-story cold-storage warehouse 320x160 ft. The Pennsylvania R.R.'s portion of the work involved the construction of two double-deck piers, 160x905 ft. and 125x854 ft., with facilities on the lower deck for handling freight to and from ocean steamships direct to and from trucks and rails. On the upper deck passenger-handling facilities and storage space for freight are provided, with access by an independent driveway.

approved by the council. A bond of $4,500 has been posted for faithful performance. Work is to begin within 30 days, to be completed in one year.

Mr. Seifert has issued a statement explaining that his bid was submitted at "less than cost" because interests he represents are planning to dispose of the city's sewage through a water-reclamation plan. He recently offered to take care of the sewage free of charge if delivered by the municipality to treatment plants. The reclaimed water would be used for irrigation.

On Jan. 6 the California state board of registration for civil engineers, in a letter to the San Diego council, questioned Mr. Seifert's right to enter into the contract on the grounds that he is not a registered civil engineer. The letter was referred to the city attorney, who reported that no provisions of the state law had ben violated, as Mr. Seifert had contracted to furnish engineering talent just as a contractor furnishes material and labor for any job.

Chicago May Get More Time to Construct Sewage Plant

Pursuant to the decree in the Chicago diversion case, the Sanitary District of Chicago has filed its semi-annual report on the progress of its program for the construction of sewage-disposal works. This report, which is acknowledged in orders published by the U. S. supreme court on Jan. 12, calls attention to the unexpected growth of the population of the sanitary district as disclosed by preliminary figures for the 1930 census. The implication is that because of the larger increase in population than was anticipated it may be necessary to extend the time for completion of the program.

It is stated that the North Side sewage-treatment plant is now treating about 20 per cent more sewage than had been estimated for 1930. The West Side plant also will be required to handle more sewage than was expected. The total population and industrial wastes equivalent amount to 5,602,000, it is stated.

While the sewage-treatment facilities have been operated to the extent of relieving the drainage canal of almost one-third of its load, the report states that the improvement in the quality of the water in the canal and the rivers below is difficult to notice at this time because of the diminished flow brought about as a result of the drought. Under normal conditions next season, it is believed that the effect will be more noticeable. The average monthly diversion at Lockport to June last year amounted to 8,497 sec.-ft. The war department permit of Dec. 31, 1929, authorizes the diversion of an amount not to exceed an annual average of 8,500 sec.-ft.

Structural Steel Orders and Shipments at Low Point

Structural steel bookings and shipments have been sagging since November and reached low in the last week of December. The weekly average of bookings in November-December was 27,000 tons, compared with 14,000 tons in December and only 9,000 tons in each of the latter two weeks. The number of establishments reporting to the department of commerce dropped from 122 to 102 at the end of the year. Percentage of bookings to capacity was 70 around the first of November and only 29 through December.

The decrease in shipments was nearly as severe, tonnage falling from an average of 30,000 tons in October-November to 22,000 in December, with 115 establishments reporting in the earlier period and 101 in the last week of the year. Percentage of shipments to capacity dropped from 66 to 41.

POWER COMMISSIONERS UNDER FIRE

Wide World Photo

Reconsideration of the confirmation of the appointment of three newly appointed members of the Federal Power Commission was voted by the Senate on Jan. 9, following a spirited attack upon them in the Senate for action taken by them as soon as they were sworn into office. On January 10 President Hoover declined to return the confirmations to the Senate. The three commissioners, left to right, are Marcel Garsaud, Claude L. Draper and George Otis Smith. Two of them are well known in the civil engineering field, Marcel Garsaud, consulting engineer, of New Orleans, and George Otis Smith, for many years head of the U. S. Geological Survey.

Public Development Of Power Proposed In New York State

DEVELOPMENT of approximately 2,000,000 hp. in the international section of the St. Lawrence River through the agency of a "power authority" is recommended to the New York state legislature by its St. Lawrence Power Development Commission.

The power commission was set up by the legislature last year to study and report upon the feasibility of developing New York State's share of the power in the international section of the river through a public agency. Last week the report of the commission's engineering board was made public. It was abstracted in the news pages of our issue of Jan. 8. Since that time the commission's marketing board, consisting of John P. Hogan, of the firm of Parsons, Klapp, Brinckerhoff & Douglas, consulting engineers, and John Bauer, economic consultant and statistician, and the report of its legal advisers have been made public. Both these reports were favorable.

Report of the Marketing Board

The marketing board, in its report, states that the best way to utilize the St. Lawrence power in order to preserve the direct and indirect economic advantages will be to use a certain portion of it at the site for industries requiring continuous power and to distribute the remainder in existing markets where it can be mingled with power from other sources, such as steam-generated electricity and power from inland streams controlled by storage. In view of the relatively small variation in the flow of the St. Lawrence River and the limited amount of storage, the marketing board emphasizes the necessity for thus using the St. Lawrence power to carry the base load of a diversified system in order that the plant can be operated at a high load factor. The board estimates that a saving of from $5,000,000 to $12,000,000 a year may be obtained through the development of the St. Lawrence power in comparison to developing power by other means.

State's Right Declared Paramount

The power development commission's legal advisers state: "In the absence of specific grants to use the bed of the river, the state alone has the right to construct dams or weirs or other structures in the bed of the river. The State of New York, in its proprietary capacity, is also the owner of the water power inherent in the flow of the St. Lawrence River over that portion of the bed which it owns." The legal advisers hold further that the rights of the private riparian owners are subject to the paramount power of the State of New York and of the United States to regulate and control the river in the interests of navigation, that if the State of New York undertakes to exercise its

sovereign right to improve and develop navigation (subject to approval by the United States and the International Joint Commission) it may take or destroy any and all the rights of private riparian owners within the State of New York in respect to the river without compensation. It need make compensation only for the uplands along the shores of the stream taken in the development.

Federal Power Act Invalid

As to the federal government's control over power development as expressed in the federal water-power act, the commission's legal advisers find: "So far as this act is directed to the regulation and control of such projects in relation to navigation, it is within the constitutional power of the United States government. In our opinion, however, the primary purpose of the act is not the regulation and control of navigation, but is an assertion of authority over power projects as such beyond their relation to navigation. In our opinion such assertion of authority is unconstitutional and beyond the powers of the United States government, and the federal water-power act is invalid. . . . The sole provision which appears to threaten the rights of the State of New York is the assertion of the right of recapture of the project by the United States at the end of the license period (of 50 years). In our opinion this purported right of recapture is an unconstitutional assertion of power by the United States government."

A Power Authority Proposed

In view of these favorable reports by its technical advisers and its own investigations, the commission recommends to the state legislature that a public power authority to be known as the "Power Authority of the State of New York" be created and that the trustees of this power authority be appointed without delay; that appropriate agreement with the Canadian authorities be sought as to engineering features and that a plan for cooperative development of the power be worked out with them; that the trustees seek to negotiate with utility companies a contract for the transmission and distribution of power which will insure; (*a*) payment of all operating expenses of the power plant, (*b*) interest and amortization and reserve charges sufficient to retire the bonds of the trustees in not less than 40 years and fully maintain the plant, (*c*) such charges to consumers as will insure to them the benefit of ownership, control and operation of the plant by the power authority, (*d*) continuous control and operation of the power plant by the power authority, (*e*) full and complete disclosure to the power authority of all factors of cost in transmission and distribution of power so that rate to consumers may be fixed initially in the contract and may be adjusted from time to time on the basis of new cost data, (*f*) that rates fixed in the contract shall be contractual in their legal nature and shall not be subject to rate litigation.

The commission further recommends that the trustees be granted appropriation sufficient to enable them to proceed with the preparation of plans and specifications and establish accounting facilities for ascertaining accurate data in connection with the proposed contract, such appropriation to be returned to the state out of capital funds raised by the power authority upon its corporate bonds or other securities.

The commission states: "It is not economically wise to parallel existing transmission or distribution systems except as a possible solution in the event of failure of private utility companies to enter into a contract with the public power authorities on a fair and reasonable basis." The commission does not feel that such action will be necessary, as it has held numerous conferences with representatives of the utility systems of the state and has received from them an expression of their willingness to enter into contractual agreement with the power authority, guaranteeing to pass onto the consumer the full benefit that may result from the project. Authority to enter into such contracts in advance of construction is essential to the undertaking, in the commission's opinion, in order that the power authority may be able to market its bonds.

The life of the commission has been extended to enable it to prepare bills to put its report into effect.

Twenty Men Temporarily Trapped in Hetch Hetchy Tunnel

Collapse of some sections of 12x16-in. timbers at a point where a 5-ft. section had been removed for guniting in the Hetch Hetchy tunnel of the San Francisco, Calif., water-supply system trapped twenty men, who were subsequently released without injury. The accident occurred at 6:30 p.m. on Jan. 9 at a point 1,310 ft. from the shaft at Mitchell east and 382 ft. from the face of the tunnel. The last man was rescued from the tunnel at 11 p.m. Jan. 10.

Approves N. Y. Pier Extensions

Permission to construct 1,000-ft. piers on both the New York and New Jersey sides of the Hudson River opposite the midtown section of Manhattan was granted Jan. 13 by the war department, which approved a joint application by the department of docks of New York City and the New Jersey state board of commerce and navigation. Despite the advancement of the pierhead lines, a fairway will remain with a width varying from 2,800 to 3,500 ft. wide. The decision clears the way for a dock-improvement program involving an expenditure of approximately $75,000,000, as well as for the northward extension for New York's West Side elevated highway, the first section of which was recently completed.

States Will Absorb Emergency Road Fund Within Time Limit

Washington Correspondence

ASSURANCES have been received by the U. S. Bureau of Public Roads from each one of the states to the effect that its share of the $80,000,000 emergency fund can be absorbed on projects that can be completed prior to Sept. 1. The projects on which the emergency money is to be expended will be watched closely in Washington in order that transfers may be made of any portion of the fund to a state which will be in a position to expend it within the time limit. There is full determination that the intent of the law will be carried out and the entire $80,000,000 actually expended within the period prescribed. While there will be no lowering of standards as to the quality of construction required, the bureau is granting increased powers to its district officers so that the approval of projects may be hastened.

The hope is expressed that change of administration in so many states this year will not result in unnecessary turnover in the state highway departments. Patronage desires of new governors, it is expected, will be deferred, at least until after the completion of the emergency program. Experience shows that any change in the important officers of a state highway department slows down the work materially.

In the expenditure of the emergency money preference will be given to projects in regions where unemployment is greatest. This probably means that a considerable part of the $80,000,000 will be expended in the vicinity of centers of population. In order not to impede any effort to relieve the maximum amount of unemployment, the bureau will not be so insistent as ordinarily on concentrating work on incomplete gaps between important sections of completed highway.

The bureau suggests that hand labor be used wherever it does not increase construction costs.

Appropriation Reported to Operate Hydraulic Laboratory

The commerce department appropriation bill, reported to the House of Representatives on Jan. 13, contains an appropriation of $36,880 to start operation of the Bureau of Standards hydraulic laboratory, now near completion.

Testifying before the House appropriations committee, George K. Burgess, director of the Bureau of Standards, stated that the laboratory will be completed early in the summer and that funds are necessary for personnel expenses and for equipment to operate the laboratory during the next fiscal year.

Toronto's Railway Viaduct in Full Operation

The city of Toronto's great railway viaduct, which skirts the waterfront and is an integral part of the city's railway terminal system, came fully into operation on Dec. 15. Last January six of the twelve tracks which the viaduct carries were put into use. The remaining six tracks, over which trains are now running, mark the completion of a $40,000,000 program.

The viaduct is a necessary supplement to Toronto's new union railway station, which was constructed at a cost of $7,000,000. Although formally opened in August, 1927, trains continued to arrive and depart over temporary low-level trackage pending the completion of the structure. The viaduct, which is almost 4 miles long and intended to carry twelve tracks at an elevation of 17 ft. above the city's streets, is designed to fit with the harbor improvement program. This latter work has been carried on simultaneously with that of the railway terminal.

The new terminal is operated jointly by the Canadian National and the Canadian Pacific railway systems, and the cost has been apportioned between those companies and the city of Toronto.

Work on Mettur Dam, British India, Progressing Rapidly

Remarkable progress has been made with the construction of the great dam at Mettur, on the Cauvery River, 100 miles northwest of Trichinopoli and 180 miles southwest of Madras, British India.

The dam will contain 1,852,000 cu.yd. of masonry. The reservoir will extend over 40 miles north of the river, with a perimeter of about 100 miles, and will have a capacity of 93,500,000,000 cu.ft. The over-all length of the dam is 5,300 ft. The maximum height of the storage level is 220 ft.

When the Klannambadi Dam in Mysore and the Mettur Dam are in full commission about 80 per cent of the Cauvery flow will be usefully employed. The Kannambadi and Mettur reservoirs will also have an absorptive effect on floods.

Two concreting towers, 306 ft. high, weighing about 1,570 tons and traveling along rails on the downstream toe of the dam, are now in operation. They can place concrete over a length of 126 ft. up to the full height without changing their position.

When complete the Mettur project will add 301,000 new acres of irrigation, of which 43,000 will be obtained by a 10-mile extension of an existing Tanjore canal with 86 miles of distributing channels; and 258,000 acres will come under a new canal 67 miles long with 529 miles of branches.

Light Railway Congress, 1932

By invitation of the Netherlands government, the next meeting of the International Association of Tramways, Light Railways and Road Transport will be held at The Hague in 1932.

Public Market Building Planned for Portland, Ore.

The new public market building to be erected on the waterfront between Morrison and Salmon Sts., Portland, Ore., represents a $1,500,000 investment, of which $600,000 is for the building alone. The structure, 180x616 ft., will cover a ground space of 106,876 sq.ft. The major portion of the building will be one story in height, with a mezzanine floor covering 35,000 sq.ft. Cold and dry storage plants will be contained in a 50x200-ft. section constructed to a height of four stories. Parking space on the roof, available through ramps, will provide storage for 650 automobiles. Ross B. Hammond, Inc., will be the contractor.

This market building, which is to be privately owned by the Portland Public Market Corporation, will provide stalls for 330 farmers as well as space for regular storekeepers. The public market now in existence occupies space in the public thoroughfare on two sides of Yamhill St. from Third to Fifth St.

Salt River Valley Water Users Assn. Is a Public Utility

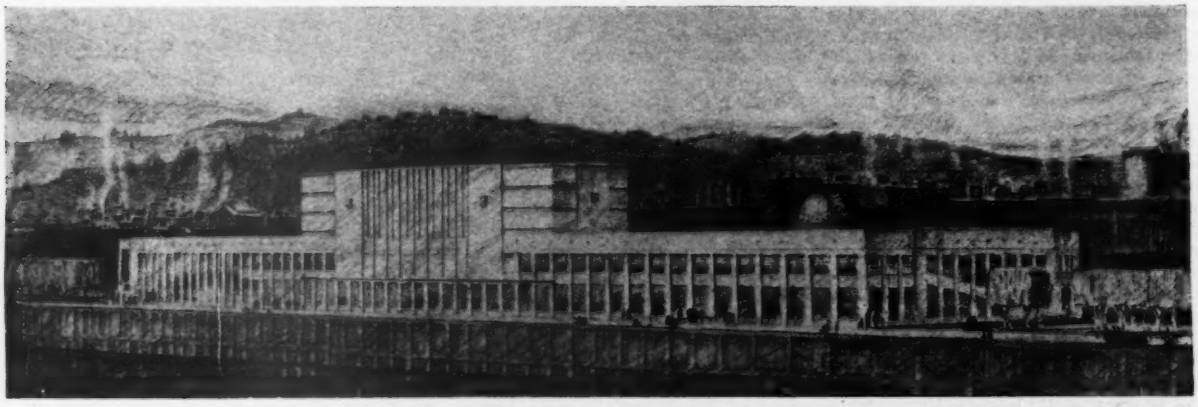
As the result of the application of the Salt River Valley Water Users' Association, Phoenix, Ariz., to the Arizona Corporation Commission for authority to incur indebtedness above the amount to which it has heretofore been automatically restricted by state law, the commission has issued an opinion that the association is a public service corporation or public utility, and has fixed at $22,000,000 the amount of indebtedness to which the association may subject itself.

It was explained by the commissioners that the order would have the effect of requiring the water users to secure corporation commission approval of all corporate acts, rates and other matters which the commission governs for all public utilities.

The water users' association has built and operates, in conjunction with the reclamation project in the Salt River Valley, the Roosevelt, Mormon Flat, Horse Mesa and Stuart Mountain power projects.

Wood Preservation Meeting

At the annual meeting of the American Wood Preservers' Association, to be held at Philadelphia, Pa., Jan. 27-29, the program includes, besides a number of committee reports, the following papers: "Diversity in Uses of Treated Timber," R. S. Belcher, Santa Fe Ry.; "Treated Timber in Construction," R. O. Dufour, United Engineers & Constructors Co.; "Treated Ties on the Lehigh Valley R.R. for 21 years," C. B. Musselman, chief treating inspector; "Wood Preserving in Europe," Herman von Schrenk, consulting engineer. Reports from the U. S. Forest Products Laboratory will include fireproofing of wood, permanence of creosote, the international termite exposure test, marine piling experiments and the toxicity of various wood-preserving chemicals. The secretary of the American Wood Preservers' Association is Horace L. Dawson, Washington, D. C.



New Public Market in Portland, Ore.

WASHINGTON NOTES

By PAUL WOOTON
Washington Correspondent

Efforts to Speed Up Emergency Construction by Cutting Out Red Tape—Flood-Control Plans Heard

A BILL authorizing the secretary of the treasury to restrict bidding on construction to such persons, firms or corporations as possess the qualifications deemed necessary is objected to in the House on the ground that it concentrates too much power in an executive department. Before the bill was reported out of committee a provision was eliminated which would have enabled the secretary to suspend competitive bidding in special cases.

In order that the House bill may be passed, an attempt is being made to adopt a qualifying clause that will satisfy the opposition. It has been suggested that the secretary of the treasury can be permitted to invoke a policy of prequalification for certain emergency situations without being given such wide authority for general use. The bill also permits the government to suspend competitive bidding for surveys of building sites and for engineering services.

Another bill relating to the public building program has been referred to the Senate committee on public buildings and grounds. This measure, sponsored by Senator Smoot, authorizes the secretary of the treasury to appoint twelve committees to assist in the selection of sites for public buildings. The sites selected by such committees would be subject to the approval of the secretary of the treasury.

Louisiana's Flood-Control Plans

Hearings were held by the House flood-control committee last week to obtain alternate proposals from the Louisiana state board of engineers in the event that the army engineers report that the reservoir plan proposed by the board would not be practicable at this time. Harry Jacobs, state engineer of Louisiana, submitted a tentative plant for west bank diversions. He made it clear, however, that he still recommends the original Louisiana plan for the elimination of the Boeuf floodway by means of reservoirs in the Arkansas and White rivers.

While he believes that the army engineers are making a real effort to determine the facts in connection with the value of the proposed reservoirs, Mr. Jacobs told the committee that Louisiana is prepared to challenge the figures of the government men should they report adversely on the storage project. If the army engineers report that the proposed reservoirs would be too costly or would not provide the necessary relief, Mr. Jacobs stated that the state authorities are prepared to engage engineers of national reputation to make a restudy of the situation.

If it is developed that it is impossible to build reservoirs at this time, Mr. Jacobs provides in his tentative plan for a controlled and regulated floodway through the Boeuf basin. In discussing the details of his plan, Mr. Jacobs stated that his general purpose is to carry the floods through the Atchafalaya basin by enlarging the Atchafalaya River rather than by building a floodway.

The committee also listened to proposals by J. P. Kemper, Louisiana engineer representing the Atchafalaya Protective Association, for a combined floodway and ship channel through the Boeuf basin. In place of a controlled diversion, Mr. Kemper advocates a constanly flowing floodway which could be used by river traffic as a cutoff.

Cooperation With Mexico on Water

The President has asked Congress for an appropriation of $287,000 for a continuance of a cooperative study with Mexico of a plan for the equitable use of the waters of the lower Colorado River, the Rio Grande and the Tia Juana River. The study is under the direction of the International Water Commission of the American section, of which Elwood Mead is chairman.

Plans for Reconstructing Bridge at Vancouver

Alternate projects, such as a dam and locks, or reconstruction of the Second Narrows bridge at Vancouver, B. C., to the west of the present site, where the channel is wider, will be considered by L. E. Cote, chief engineer of the federal department of marine, who has arrived in Vancouver to investigate the situation. The center span of the bridge was carried away by a log-gathering steamer on Sept. 15. Recently the span was successfully raised.

The Business Outlook

Things are pointed upward as the new year begins. Business is getting back to the job and starting out vigorously to test the possibilities of improvement. Workers are being recalled after shutdowns for holidays or inventory taking. Steel activity has rebounded sharply to the end-of-November level, with improved demand. Automobile production continues the unusual rise that began in December. Building contracts started the year at an encouraging level. Most other indicators have ceased to decline. Commodity prices are stronger. Most encouraging of all the familiar features of the bottom of this depression is the steady and rapid rise in bond prices since the middle of December.

—The Business Week, Jan. 14.

St. Louis Officials Cleared of Charges; Resume Old Jobs

John C. Pritchard, who resigned as director of public utilities for St. Louis, Mo., several months ago following his indictment in connection with a street-lighting contract and against whom all charges have been dismissed by Circuit Attorney Miller, has been reappointed to his old position by Mayor Miller.

George B. Heath, also indicted with Pritchard and against whom all charges have been dismissed, has been reappointed superintendent of electrical construction and maintenance.

Jean L. Rilliet, Jr., who served as director of public utilities while Pritchard was under charges, will again become division engineer in charge of heat, light and power.

Delay in Water Certificate Sale Turns Premium Into Discount

Chicago water certificates having a value of $7,000,000, on which a banking syndicate had recently held an option to purchase at a premium, were sold on Dec. 29 to the same syndicate at a discount of $350,000. The sale disposes of part of a $12,000,000 issue authorized by the Illinois legislature in 1929 but the legality of which was subsequently attacked in court. In October the banking syndicate took a 60-day option to purchase $10,997,000 worth of the certificates at a premium of $85,000, the purchase to be completed providing the state supreme court established the validity of the certificates within the option period. The court's decision was handed down on Dec. 18, as reported in *Engineering News-Record* of Dec. 25, 1930, p. 1024. As the option to purchase had expired, new bids were invited and the highest offer was at the discount stated. Since October the market for municipal securities has declined sharply due to the great number of issues put out following the November elections. The city's authority to issue the certificates expired on Dec. 31, 1930. The remainder of the $12,000,000 authorized will be withheld.

British Columbia Company to Develop Goat River Power

The South Kootenay Water Power Co., of Creston, B. C., has been granted a license by the British Columbia government to develop the Goat River Falls, about 4 miles east of Creston. This power site was staked by the South Kootenay company more than two years ago, but on making application for water rights the company was given notice that a reserve had been placed on the stream. The reserve has now been lifted, and the company immediately restaked the power development and at the same time the Creston Power & Light Co., Ltd., also applied for a license to develop this power.

Brief News

RECORD TONNAGE through the New York state barge canal was registered in 1930, the traffic totaling 3,605,457 tons, a gain over 1929 of 729,297 tons.

AIRPORTS AND LANDING FIELDS in the United States numbered 1,782 at the close of 1930, as reported by the aeronautics branch of the department of commerce. An increase of 125 took place between July 15 and Dec. 31.

THE SECRETARY OF WAR has approved the application of the board of transportation of the city of New York to construct twin vehicular tunnels under the East River from the foot of East 37th St. and the foot of East 38th St., Manhattan, to Borden Ave., Queens.

UNDER THE PROVISIONS of a bill introduced in the New York State Senate it is provided that manual labor shall be substituted for machinery and labor-saving devices upon all public work whenever practicable or expedient during the unemployment emergency.

CONSTRUCTION of a 26-in. gas line from Kettleman Hills to Los Angeles and Long Beach, Calif., is planned by the Southern Fuel Co. The line will have a capacity of 130,000,000 cu.ft. per day and will cost $7,000,000.

THE NEW WATER TOWER of the Des Moines, Iowa, water-works will be called the "Allen Hazen Tower," in honor of the late Allen Hazen, who helped design the structure. The tower will have a height of 100 ft. and a diameter of 130 ft. It will be surrounded by fifteen columns, each 6 ft. in diameter and 50 ft. high.

A FEDERAL SURVEY is being made on the channels leading from the Gulf of Mexico to Tampa, Fla., docks with a view to obtaining a 30-ft. channel into Tampa. The work was recently authorized by the Chief of Engineers and will take about four months to complete. The present channel has a depth of 27 ft.

PERMISSION for Columbus, Ohio, to issue bonds up to $6,500,000 to finance construction of the proposed sewage-disposal plant has been granted by the state authorities. The first bond issue expected to be passed by the city council will be to acquire a site for a plant about 3½ miles south of the present site.

THE RECENTLY COMPLETED BRIDGE across the Genesee River at Rochester, N. Y., was dedicated on New Year's Day. It will be known as the Bausch Memorial Bridge, in honor of John Jacob Bausch, founder of the Bausch & Lomb Optical Co.

THE TRANSPORTATION BUREAU of the Amtorg Trading Corporation has announced that it is organizing a group of about 150 railroad men to be sent to Russia to assist in modernizing the Russian railway system. The group, which will comprise engineers, yard-masters, switchmen and signalmen, will be under contract for one year.

CONSTRUCTION of a joint municipal electric power plant and the sale of water by Fort Lauderdale, Fla., to Hollywood is under discussion by the city commissions of both cities. Plans take care of the needs of both municipalities for pumping and street lighting and for the construction of two 250,000-gal. storage tanks in each city and the laying of 6 miles of 16-in. mains from Fort Lauderdale to Hollywood at an estimated cost of $108,000.

SOCIETY CALENDAR

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; annual meeting, New York, Jan. 21-23.

AMERICAN WOOD PRESERVERS' ASSOCIATION, Washington; annual convention, Philadelphia, Pa., Jan. 27-29.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington; annual meeting, San Francisco, Jan. 26-28.

ENGINEERING INSTITUTE OF CANADA; annual meeting, Montreal, Feb. 4-6.

NATIONAL CRUSHED STONE ASSOCIATION, Washington; annual convention, St. Louis, Mo., Jan. 19-22.

NATIONAL PAVING BRICK ASSOCIATION, Washington; annual meeting, Pittsburgh, Pa., Feb. 4-6.

NATIONAL READY MIXED CONCRETE ASSOCIATION, first annual convention and exhibit, St. Louis, Mo., Jan. 26.

NATIONAL SAND AND GRAVEL ASSOCIATION, Washington; annual convention, St. Louis, Mo., Jan. 27-29.

ENGINEERS' CLUB of Memphis on Jan. 8 elected officers for 1931 as follows: president, Major L. D. Worsham, U. S. Army, assigned to the Memphis office, U. S. Engineers; vice-president, Ward Barnum; secretary and treasurer, John J. Ryan. Prizes were presented to three members who had been 100 per cent perfect in attendance during the year.

NASHVILLE ENGINEERING ASSOCIATION, at its meeting on Jan. 5, installed officers as follows: president, W. F. Pond; vice-president, J. M. Farrar; treasurer, E. W. Bauman.

NEW YORK SECTION, American Society of Civil Engineers, was addressed at its regular meeting on Jan. 7 by W. A. Starrett, vice-president, Starrett Brothers & Eken, who described the construction of the 72-story Manhattan Company Building, recently completed in New York under one of the shortest and most exacting time schedules that has yet been used in the field of building construction. Colonel Starrett paid tribute to the foundation contractors, Spencer, White & Prentis, who installed the piers while the old buildings on the site were being erected; to the steel contractor, the Levering & Garrigues Co.; to the other subcontractors, and to Mr. Eken, who planned and directed the whole work. Several reels of motion pictures were shown, depicting the operation from beginning of demolition to inclosure of the final spire. Refreshments were served after the meeting.

ROCHESTER SECTION, American Society of Civil Engineers, has elected the following officers: president, C. Arthur Poole; vice-president, Robert B. Jeffers; second vice-president, Henry L. Howe; secretary-treasurer, Carl C. Cooman.

WESTERN METAL AND MACHINERY EXPOSITION will be held in San Francisco, Calif., Feb. 16-20, with the cooperation of a number of technical societies including the American Society of Mechanical Engineers, American Institute of Mining and Metallurgical Engineers, Society of Automotive Engineers, American Chemical Society, Pacific Coast Gas Association and American Welding Society. Under the sponsorship of the latter four papers will be presented: "Electric Arc Welding," by A. F. Davis, Lincoln Electric Co.; "Fusion Welding," by J. C. Hodge, Babcock & Wilcox Co.; "Welding of Alloy Overlays," by Miles C. Smith, Stoody Co.; and "Welding Aluminum and Its Alloys," by W. M. Dunlap, Aluminum Company of America.

Personal Notes

B. C. ALLIN, for twelve years director of the port of Houston, Tex., has been appointed director of the port of Stockton, Calif. He will manage Stockton's $6,000,000 port development and deep-water ship-channel project, which will include a harbor with terminal facilities to accommodate worldwide shipping.

WILLIAM JUDSON GRAY has resigned as superintendent and engineer of the Springfield City Water Co., Springfield, Mo. Mr. Gray had held that position for seven years and plans to take up practice as a consulting engineer, having had eighteen years' experience in the water-works and construction fields.

E. G. EGGERT, for the past twelve years assistant sanitary engineer of the Texas state department of health, has announced his resignation from that office to engage in private practice, with headquarters in Austin. Mr. Eggert will specialize as consultant in the water-supply and sewage-disposal field.

HENRY F. ALEXANDER, formerly director of public service, Lorain, Ohio, has been appointed city engineer of Lorain, succeeding Chalmers C. Miller, who has been city engineer since 1918 and who resigned recently to accept appointment as chief of the engineering staff of the Municipal Research Bureau of Dayton, Ohio.

Obituary

WILLIAM EARL HOLMES, of Aberdeen, Miss., a civil engineer for the Mississippi state highway department, died in Memphis on Jan. 8.

FRITZ BRAND, 25 years old, an engineer employed by the Illinois state highway department, was killed on Dec. 31 in an automobile collision at Peoria, Ill.

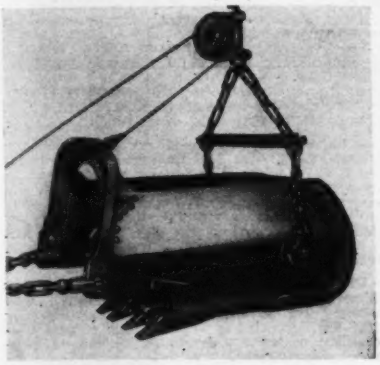
GEORGE KUPPLER, contractor, of Port Angeles, Wash., a member of the contracting firm of Chris Kuppler & Sons, which constructed many of the Pacific Northwest paper mills, died recently as the result of injuries received in an automobile accident.

WARREN H. KNOWLTON, retired civil engineer, died on Jan. 3 in Denver, Colo., where he had taken up his residence about twenty years ago. Prior to that time he had been on the engineering staff of the Great Western Railroad, and at one time was associated with the New York Central Railroad. Mr. Knowlton was 83 years old.

Construction Equipment and Materials

Dragline Bucket Improved

Through scientific design and the use of special alloy steels a dragline bucket of high strength and unusually light weight has been developed by the Northwest Engineering Co., Chicago, Ill. The outstanding feature of the new design is in the arch, which is a cast I-beam section which will stand shocks that crumple plate work. The bucket hitch is so placed that blows from striking

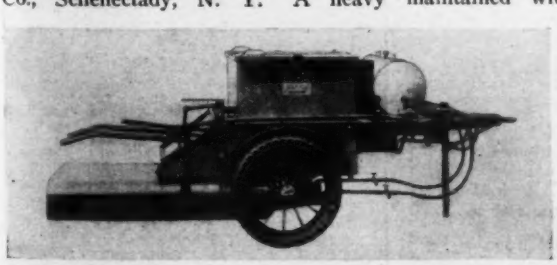


Welded dragline bucket

the bank are taken on this arch and not on the side plates. The lip differs from the usual casting in being of rolled alloy steel. This is welded directly to the arch, and the two are heat-treated as a unit. A single piece of material, welded at the corners, forms the basket, or load-carrying, portion of the bucket. To promote cable life the dumping sheave has received special attention, both it and the hoist trunnion pins being of hardened steel. All welding on the bucket is done by a special method, as it has been found that ordinary arc welding is not suitable to withstand the shocks of dragline operation.

Triple Heater Combination

Three pieces of equipment are combined on a single chassis in the Hotstuf Three-in-One combination tool, asphalt and surface heater which has been announced by the Mohawk Asphalt Heater Co., Schenectady, N. Y. A heavy channel-section chassis equipped with semi-elliptic springs and rubber-tired, roller-bearing wheels carries a tool-heating compartment which will deliver sixteen paving tools, ready for use, five minutes after lighting the heating torches, according to the manufacturer. The bottom of this compartment is lined with 2-in. angles as reinforcement and to provide a surface free from obstructions. This outfit is heated by two torches and can be purchased singly, provided with a rack for melting small quantities of asphalt in buckets. For larger quantities, as asphalt-heating kettle can be attached directly to the frame of the tool heater by bolts, these being easily removable when the asphalt heater is not needed. Fittings are also provided on the frame for the attachment of the surface heater, which is swung between the wheels and may be raised for towing. This unit uses two additional torches and will quickly heat a surface 3x5 ft. in size. To retain the heat on the pavement a hood is provided made of heavy-gage metal with reinforced edges and asbestos insulation.



Asphalt, tool and surface heater

Spring Maintains Tension on Highway Guard Cables

Maintenance work necessary to compensate for the effects of varying temperatures on highway guard cable is eliminated by the new cable anchorage and attachment devices developed by the Malleable Iron Fittings Co., Branford, Conn. Proper cable tension is maintained within narrow limits by means of a compression spring anchorage consisting of a double thimble strain block to which the cable ends are clipped; a slide fitting on an anchor rod; and a compression spring. Two types of the latter are used, rating at 880 and 1,650 lb. resistance when fully compressed. Not only does this unit keep the cable taut but it also acts as a shock-absorber, up to the limit of its capacity, when a vehicle strikes the fence. Cable tension can be adjusted by turning a nut at the upper end of the spring.

Guard cable anchorage and fittings

In order that the spring anchorage may act properly, it is necessary to attach the cables to the posts firmly, yet in a manner which allows slippage in a longitudinal direction. For this purpose pillow block units are available fitted with special shoulder-type J-bolts for use with wood or concrete posts.

Chisel Driven by Air

Small quantities of soft metals, stone or wood can be quickly and accurately removed by the use of the Kipp air chipper, a new device developed by the Madison-Kipp Corp., Madison, Wis. As the name implies, this tool is driven by air, operating at pressures of from 60 to 100 lb. It can deliver over 6,000 blows per minute and is controlled by means of a simple trigger valve. The intensity of the chisel strokes is regulated by the position of this valve and the pressure which the operator exerts against the tool. This makes it possible to work to extremely close limits. As the illustration shows, the air chipper resembles a pistol. Its length is 5⅞ in., its weight 1½ lb. Chisel shanks are pentagon in shape and can be inserted with any of the five sides in an upward position. This gives the operator freedom of action for proper clearance and convenience.

Pneumatic chisel

Two New Drafting Tables

Quick adjustment and maximum convenience are features of two new tables for draftsmen which have been announced by the Hamilton Mfg. Co., Two Rivers, Wis. The first of these, called

Combined drafting and reference desk

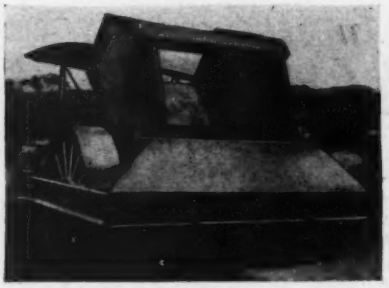
the auto-shift drawing and reference table, is intended to be used in a row with several similar units, as it is planned so that each draftsman uses parts of two tables. The drawing upon which he is working is mounted on the drawing board top of one desk, while his ink, drafting tools and reference drawings are carried on the adjacent desk. The drawing board top can be raised or depressed to any convenient height, the brakes which hold it in position being released by means of a foot lever. Changes in the angle of the board are made with the aid of a release rod which runs across the front of the board under the edge. When the auto-shift table is used individually a swinging instrument cabinet is used to hold instruments and ink bottles. Steel, finished in olive green, is used for the body of the table. The drawing board is of selected pine, varnished on both sides. Sizes available range from 36x60 in. to 42x84 in.

An illuminated desk for use in tracing drawings or in retouching photographs is the second new device announced by this company. This table, which is adjustable in height or slant, is equipped with a 22x24-in. plate-glass working surface with a sandblast finish on the under side. Beneath this are a reflector and an illuminating device consisting of two electric lights. Intensity of light is controlled by a rheostat. The frame of the table is made of birch with a top of selected basswood. Dimensions of the top are 32x31 in., and its height can be varied from 23½ to 42 in.

Wheeled Scraper Regulated by Hydraulic Cylinders

Depth of cut with the improved wheel scraper produced by the Shaw Excavator & Tools Co., Worthington, Ohio, is regulated by hydraulic pressure. The scraper, which is available in 1½-, 2¼- and 4-cu.yd. sizes for use with tractors developing 20, 30 and 50 drawbar horsepower, consists of a bucket swung from the top rear corners of a heavy frame mounted on two wide-tired steel wheels. The height of the cutting edge, which is bevel edged and reversible, is regulated by two hydraulic cylinders of the telescopic type, one on each side, which are supplied with oil by a pump mounted on the power takeoff of the tractor. This pump operates continuously, so that raising or lowering of the bucket is accomplished quickly without stopping or changing gears. Regulation of the amount of oil in the cylinder determines the height of the cutting edge.

In loading, the operator allows the front end of the bucket to drop while the tractor is moving forward. When it is loaded the front end is raised so that the bottom is level and about 8 in. clear of the ground. At this point the cutting edge comes very close to a stationary plate at the front of the scraper, while the rear of the bucket is closed by a second plate. Thus the load is fully



4-cu.yd. scraper in dumping position

inclosed and can be transported at full speed to the dump. To discharge, the operator raises the cutting edge still higher, so that the bottom of the bucket stands at an angle of about 70 deg. The contents drop out of the rear and are distributed by the rear plate, which can be fixed for spreading or allowed to swing free.

Two Eight-Cylinder Motors Drive Heavy High-Speed Truck

What is claimed to be the most powerful truck ever built, designed to carry loads of from 20 to 40 tons at speeds hitherto considered impossible, has been announced by the Relay Motors Corp., Lima, Ohio. This large

Front of dual-drive truck

transportation unit is equipped with two eight-cylinder truck-type engines with a combined rating of 275 b.hp. at 2,800 r.p.m. The truck is mounted on six wheels, and each motor delivers power to a separate rear axle through a separate transmission and differential. An air mechanism shifts the twin transmission gears in perfectly sychronized time. The two rear axles are built on the Relay principle, which suspends the load like a pendulum, allowing it to swing back and forth and reducing the horizontal impact of all rear wheels. Because of the unusual transmission it is possible to drive the truck with either or both motors, permitting the development of full power for heavy loads and economy in gasoline and oil consumption, when unloaded, by operation with only one engine. Despite the high power and capacity of the truck, its manufacturers claim that little damage will be done to the highway, because of the six-wheel support, balloon tires and scientific cushioning.

New Publications

Lead—The first issue of the trade publication "Lead," published by the Lead Industries Association, 420 Lexington Ave., New York City, is now being distributed.

Wire Rope—"Wire Engineering" is the title of a new house magazine, the first issues of which are being distributed by the JOHN A. ROEBLING'S SONS CO., Trenton, N. J.

Flooring—Advantages of Mastic wood-block flooring, which is placed directly on concrete, are outlined in a 24-p. illustrated bulletin of the WOOD-MOSAIC CO., INC., Louisville, Ky.

Diesel Excavator—Model 52-B, the new 2¼-cu.yd. diesel shovel-dragline-clamshell-crane developed by the BUCYRUS-ERIE CO., South Milwaukee, Wis., is fully described in a 16-p. illustrated bulletin issued by that company.

Graders—A new and smaller model of the Caterpillar leaning wheel grader, to be used with the Caterpillar 30 tractor, is described in a 4-p. bulletin of the CATERPILLAR TRACTOR CO., Peoria, Ill.

Pipe Joints—Practical information on cast iron pipe-jointing practice is given in a 32-p. illustrated bulletin of the HYDRAULIC DEVELOPMENT CORP., 50 Church St., New York City. Not only does this publication describe the methods and materials used but it also contains specifications and tables applicable to this field of construction.

Lightweight Floors—Circular 43 of the PORETE MFG. CO., 346 Riverside Ave., Newark, N. J., describes a new lightweight floor system with a weight of only 35 lb. per square foot and up, depending upon the depth. The construction consists of steel joists resting on steel girders and entirely embedded in Porete lightweight concrete.

Electrical Apparatus—WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa., has issued a large general catalog for 1931-32 containing 1,352 pages and describing many hundreds of pieces of electrical equipment. An illustrated introductory section presents a brief history of the company and its plants and a description of interesting research developments.

Water Treatment—"Chemical and Mechanical Utilization of Activated Carbon in Water Purification," a paper presented by A. S. Behrman and H. B. Crane before the American Water Works Association, has been reprinted as technical bulletin 6003 by the INTERNATIONAL FILTER CO., 59 East Van Buren St., Chicago, Ill. The paper deals with Hydrodarco, the special brand of water-purification carbon sold by this company, and describes its field of usefulness. Underlying principles to be followed for proper design and operation are stressed, and mention is made of results secured from installations. The cost of treatment is discussed at length.

COSTS AND CONTRACTS

E. N.-R. Index Numbers

Cost		Volume	
Jan. 1, 1931	**194.48**	**December, 1930**	**192**
Dec. 1, 1930	196.86	November, 1930	207
Jan. 1, 1930	208.96	December, 1929	166
Average, 1930	202.85	Average, 1930	260
Average, 1929	207.02	Average, 1929	317
1913	100.00	1913	100

This Weeks' Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of Jan. 15, with some comparisons, total as follows:

(In Thousands of Dollars)

	Jan. 15, 1931	Average of Last Four Weeks 1931-30	1930-29
Buildings:			
Industrial	$2,323	$3,072	$6,398
Other	10,416	16,357	16,320
Streets and roads..	8,670	4,731	6,568
Other eng. constr..	34,167	24,078	10,271
Total	$55,576	$48,239	$39,558

Total, all classes Jan. 1 to 15:

1931	$160,195
1930	139,497

Current Construction Unit Prices

Ohio Highway Contracts—1929 and 1930

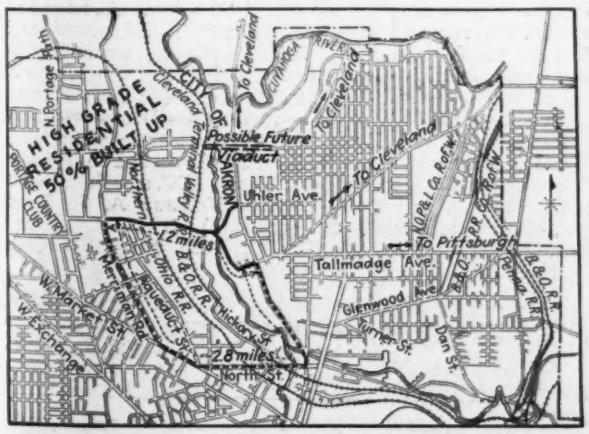
COSTS per mile of Ohio state highway work placed under contract in 1929 and 1930 are given in the accompanying tabulation. Totals for the two years are $14,770,515 in 1929 and $25,371,121 in 1930. The largest item was paving, amounting to $11,256,982 in 1929 and $16,129,273 in 1930. This item includes grading, drainage structures, and 53 bridges of more than 20-ft. span in 1929 and 155 such bridges in 1930. In addition to the items listed there were items of $134,896 for guard rail in the first year and $333,209 in the second year.

	1929		1930	
	Miles	Per Mile	Miles	Per Mile
Paving, incl. grading, drainage struc., 53 bridges in 1929 and 102 in 1930	310	$36,400	431	$37,400
Traffic bound macadam	20	17,500	67	15,300
Grading and drainage	21	15,000	36	20,400
Bridges	64	19,300	109	18,400
Small structures	24	9,950	...	...
Surface treating	720	850	1,008	1,545
Weed mowing	501	308	...	...
Concrete, widen and resurface	...	...	25	19,300
Brick, widen and resurface	...	...	19	40,300
Bituminous, widen and resurface	...	...	6	10,650

Grading and Sewers in Akron

CONTRACT was let by the department of public service of Akron, Ohio, in November, 1930, for widening West Tallmadge Ave. from Cuyahoga St. to Merriman Road, and extending Uhler Ave. from Cuyahoga Ave. to Tallmadge Ave., for $123,964. This is one of four contracts comprising the work covered by $490,000 bonds voted in November, 1928. The three others are: (1) acquiring land (completed); (2) constructing bridge over the Cuyahoga River, to be erected by the commissioners of Summit County to replace an old county bridge washed out in 1913; (3) paving, to be awarded late in 1931. This whole improvement is the result of years of agitation for a North Hill-West Hill connection. At present West Hill can be reached from North Hill only through the center of the city. It is possible that a viaduct, similar to the North Hill viaduct, will ultimately be constructed across the valley, as shown on the accompanying map.

Tallmadge Ave. will have a 60-ft. roadway with 10-ft. sidewalks. Work consists of grading (87 per cent of cost) and constructing sewers, preliminary to paving. Seventeen bids were received, and unit prices are given of the lowest two bidders: A, Shullo Construction Co., 1200 Home Ave. (contract), $123,964; B, Frank George, $128,527.



Location of Tallmadge and Uhler Ave. improvement in Akron

	A	B
288,000 cu.yd. grading	$0.23	$0.21
20 cu.yd. trench excavation	1.00	.50
2,000 lin.ft. under-drainage 6 in. pipe	.25	.50
700 lin.ft. inlet connections 12 in. pipe	1.00	1.10
45 lin.ft. inlet connections 15 in. pipe	1.25	1.50
110 lin.ft. inlet connections 18 in. pipe	1.50	2.00
100 lin.ft. sewers 6 in. pipe	1.00	1.00
15 lin.ft. sewers 8 in. pipe	1.25	4.00
23 manholes complete	90.00	125.00
80 lin.ft. manholes rebuilt	10.00	8.00
36 inlets 9 in. walls	40.00	30.00
2 inlets 18 in. wing wall	60.00	40.00
450 cu.yd. concrete class 1	14.00	15.00
200 cu.yd. concrete class 3	12.00	10.00
60 cu.yd. concrete class 4	9.00	35.00
10 cu.yd. brick masonry	15.00	25.00
26,000 lb. reinforcing steel	.06	.04
6 street signs acc. No. 5960	15.00	15.00
500 cu.yd. cinders	1.50	1.20
5 traffic reflectors	20.00	15.00
2,850 sq.ft. wire mesh	.5	.04
100 lin.ft. highway guard fence	2.50	.65
50 lin.ft. 30 in. brick drain	6.25	6.00
160 lin.ft. 36 in. brick drain (culvert)	5.50	7.00
1,440 lin.ft. 39 in. brick drain	7.60	11.00
425 lin.ft. 48 in. brick drain	9.50	9.00
165 lin.ft. 48 in. brick drain in tunnel	17.00	30.00
465 lin.ft. 54 in. brick drain	10.00	10.00
560 lin.ft. 12 in. V.P. drain	2.25	2.25
820 lin.ft. 15 in. V.P. drain	1.85	3.25
480 lin.ft. 18 V.P. drain	2.25	3.00
65 lin.ft. 24 in. V.P. drain	4.00	4.00
1 drop manhole	275.00	300.00
1 intercepter inlet "A"	100.00	300.00
1 intercepter inlet "B"	100.00	225.00
1 T or Y branches on 12 in. V.P.	2.00	2.00
1 T or Y branches on 15 in. V.P.	2.25	3.00
1 T or Y branches on 18 in. V.P.	2.50	4.00
4 6 in. V.P. stubs or slants	1.00	1.00
2 8 in. V.P. stubs or slants	1.25	1.00
1 12 in. V.P. stubs or slants	1.50	2.00
2 18 in. V.P. stubs or slants	1.75	3.00
2 6 in. V.P. bends	1.00	1.00
3 headwalls	50.00	200.00
300 cu.yd. gravel refill	4.00	3.50
6,500 lin.ft. piles	1.15	1.00
50 m.ft.b.m. sheeting left in place	30.00	40.00
30 C.I. tide or flap gates	20.00	25.00
Total	$123,964	$128,527

Lorain-Central Bridge, Cleveland

THE Lorain-Central bridge being built by Cuyahoga County, Ohio, forms an important traffic link between downtown Cleveland and the territory across the Cuyahoga River to the west and southwest. The total length of the structure is 4,490 ft., of which 2,886 ft. is of steel construction consisting of a 149-ft. deck truss and thirteen deck cantilevers varying in span from 176 to 299 ft., the longest spanning the river at a height of 141½ ft. The bridge will have two decks, the upper comprising one 60-ft. roadway and two 7-ft. sidewalks; the lower two car tracks and two 18-ft. roadways. Only the upper deck will be completed at the present time. The estimated cost is approximately $8,000,000.

Contract I covers the two river piers, which are founded on clay 40 ft. below the water level. It was let to the Walsh Construction Co., 17472 Norton Ave., Lakewood, in March, 1930, for $279,612. Contract II, for the ten remaining piers, two pylons and the east abutment, on concrete piles, was let to the Lowensohn Construction Co., 1740 East Twelfth St., Cleveland, in May for $878,962. Contract III, for the steel superstructure, was let in September to the Mount Vernon Bridge Co., Mount Vernon, for $1,210,950. Contract IV, for the approaches and deck, was let in December to Lowensohn for $1,660,107.

Unit prices are given of the lowest three bidders on the principal items of contracts I, II and IV. The unit price on the steel superstructure was $103.50 per ton for 11,700 tons. The bidders are: (I) A, Walsh Construction Co.; B, Lowensohn Construction Co.; C, Roy Black, Cleveland; (II) A, Lowensohn Construction Co.; B, Sam W. Emerson Co.; C, Aronberg-Fried Co.; (IV) A, E. H. Latham Co., Columbus; B, Lowensohn; C, Hecker-Moon Co., Cleveland.

Fred R. Williams is county engineer and A. M. Felgate

county bridge engineer. Wilbur J. Watson and F. R. Walker are consulting and designing engineers and architects for the structure.

CONTRACT I—TWO RIVER PIERS

	A	B	C
11,600 cu.yd. excav. and backfill	$8.88	$7.00	$10.50
1,900 cu.yd. footing concrete in place	9.95	13.00	12.00
5,420 cu.yd. pier concrete in place	19.60	22.00	22.00
537,000 lb. of reinforced steel in place	.35	.05	.04½
1,032 cu.yd. reinforced concrete in place	10.00	9.00	13.50
3,300 lb. anchor-bolts in place	.12	.12	.14
13,900 lb. wrought iron pipe drain in place	.10	.18	.11
10,350 lin.ft. creosoted piles in place	130.00	150.00	125.00
30 M. ft. b.m. creosoted lumber in place	192.00	230.00	110.00
290 sq.yd. waterproofing	.84	1.30	.85
1,200 lb. coal hole rings and covers in place	.09	.10	.085
1,000 hr. labor incl. foreman	1.00	1.00	1.00
Totals	$279,612	$288,098	$321,514

CONTRACT II—TEN PIERS, TWO PYLONS, EAST ABUTMENT

	A	B	C
800 lin.ft. 12 in. temp. water line	$25.80	$20.75	$15.00
800 lin.ft. 16 in. temp. water line	26.20	18.25	15.00
600 lin.ft. 12 in. vit. sewer pipe	.85	4.00	1.50
6 manholes complete	150.00	150.00	150.00
43,000 cu.yd. excavation	2.56	3.30	2.60
150,000 lin.ft. cast-in-place piles (3-a)	1.24	1.25	1.20
150,000 lin.ft. precast piles (3-b)	1.35	2.20	1.75
12 pile tests	360.00	350.00	300.00
8,000 cu.yd. footing concrete	10.00	11.00	14.50
19,700 cu.yd. pier concrete	17.50	17.50	23.00
1,070 tons reinforced steel in place	70.00	62.50	70.00
30,000 lb. anchor bolts, sleeves and plates	.11	.075	.10
1,260 lb. stainless anchor bolts	.71	.75	.50
10,000 lb. W. A. pipe downspouts	.17	.175	.12
490 lin.ft. 6 in. trench drains	.41	.60	1.00
3,400 sq.yd. colorless waterproofing	.75	.675	1.00
8,800 sq.yd. dampproofing	.43	.40	.50
1,100 sq.yd. tunnel waterproofing	.75	.70	1.00
10,000 lb. coal hole, manhole rings and covers	.10	.08	.10
3,000 hr. labor incl. foreman	.93	1.20	1.25
12 M common brick in place	72.00	50.00	40.00
6,000 lb. miscel. steel in place	.12	0.85	.10
45 lin.ft. pipe rail incl. C.I. posts	6.00	16.00	4.00
1,400 lin.ft. inserts in place	.36	.55	.50
Totals 3-a	$862,462	$886,549	$966,130
Totals 3-b	*878,962	1,029,049	1,068,630

*Awarded contract

CONTRACT IV—APPROACHES AND DECK

	A	B	C
30,000 cu.yd. excav. and backfill	$1.25	$0.60	$2.00
12,000 cu.yd. fill for approaches	.43	.28	1.00
6,000 cu.yd. footing concrete	10.50	10.50	10.50
13,000 cu.yd. structure concrete	14.15	21.50	17.20
11,000 cu.yd. lightweight concrete "H"	17.45	22.60	22.45
10,300 cu.yd. lightweight concrete "S"	15.50	21.30	19.50
1,060 tons reinforced, ordinary	70.00	65.75	63.00
1,200 tons reinforced, fabricated	75.00	83.00	82.00
90 M. brick	35.00	35.00	60.00
1,000 sq.yd. sandstone sidewalk on cement bed	4.00	5.00	5.75
7,000 sq.yd sandstone sidewalk on mastic bed	4.00	5.00	6.10
13,000 cu.ft. granite cut stone curb	4.00	4.40	4.50
35,000 sq.yd. sheet asphalt pavement	1.69	1.40	1.80
6,000 sq.yd. brick pavement	2.50	2.30	2.70
2,200 lin.ft. granite curbing	2.50	1.60	2.15
94,000 cu.ft. cut stone masonry sandstone	5.00	5.05	5.40
94,000 cu.ft. cut stone masonry granite	7.83	7.65	8.25
13,000 sq.ft. cast aluminum rail panels	1.75	2.20	2.00
12,000 sq.yd. fabric waterproofing	1.27	.50	1.05
111,500 lb. w.i. conductor pipe	.13	.25	.23
Totals	$1,503,807	$1,660,107	$1,748,856

10,060 Ft. of Concrete Sewer in Tunnel

CONTRACT 3 of the West Side 17-ft. reinforced-concrete intercepting sewer, in tunnel, was awarded in November, 1930, by the Sanitary District of Chicago for $2,083,300. Work consists of 3,810 lin.ft. of 17-ft. sewer in earth, 6,250 ft. 17-ft. in full or part rock section, and 1,180 ft. of 8½-ft. Fig. 1 shows the location of this contract as well as of two other contracts not yet awarded. Fig. 2 shows cross-sections of the sewers. Practically all concrete is Class A, 1:2½:4½. There is some Class B, 1:3:6.

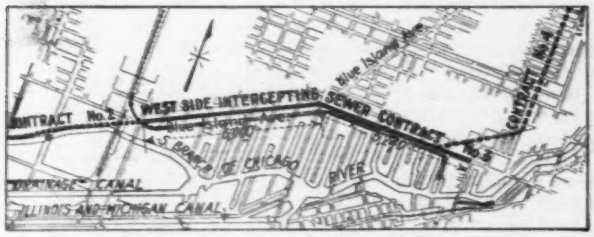


Fig. 1—Location of contracts, West Side intercepting sewer, Chicago

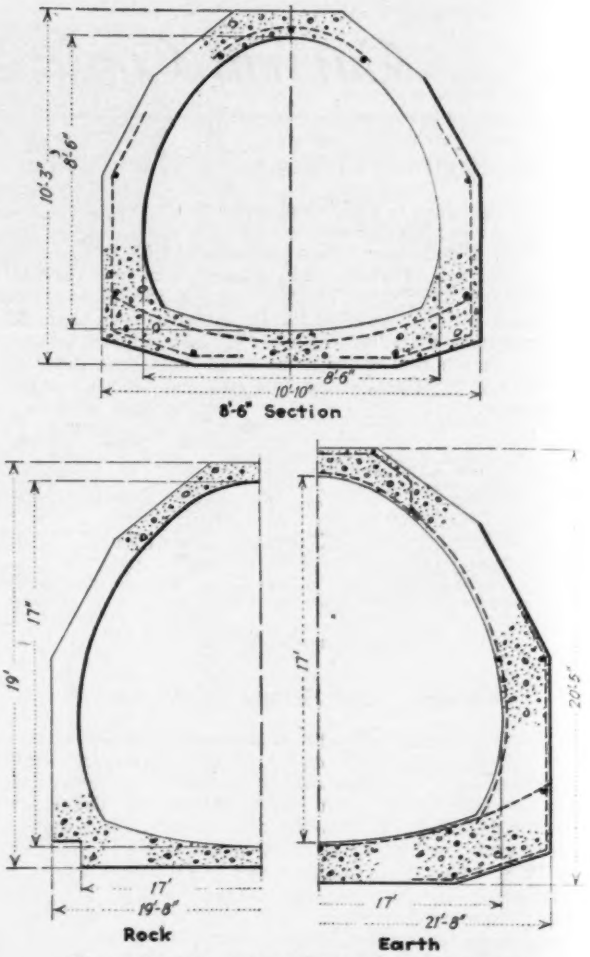


Fig. 2—Typical sections of West Side intercepting sewer, Chicago

This sewer is an important adjunct to the West Side sewage-treatment works, now under construction by the Sanitary District under other contracts. The sewer will be built from offset shafts, not on the line of the finished work. The section in rock is 40 ft. deep, with some 8 ft. overlay of dirt and medium yellow and blue clay. The earth section, also 40 ft. deep, is in blue clay. On open-cut work for shafts, pits or connections in improved streets the sewer will be constructed in tunnel under all trees 6 in. or more in diameter at a point 3 ft. above ground surface. Contract prices per linear foot are $185 for the 17-ft. sections, both earth and rock, and $55 for the 8½-ft. sewer. Averages of the ten bids received were $235 for rock, $232 for earth, and $98 for the 8½-ft. section. Additional work amounting to 200 cu.yd. in each case is provided for as follows: earth excavation in tunnel, $4.50, in open cut, $2; class A concrete in tunnel, $16, in open cut, $13; class B concrete, $10.

Work started Dec. 1, and progress is set as follows: April 1, 1931, 10 per cent; Sept. 1, 1931, 35 per cent; Feb. 1, 1932, 60 per cent; July 1, 85 per cent; Dec. 1, 1932, complete. Unit prices are given of the lowest four bidders: A, the Ryan Co., 4500 West Division St. (contract); B, Paschen Bros., Inc., 33 North La Salle St.; C, Nash Bros, 10 South La Salle St.; D. S. A. Healy, Detroit.

	A	B	C	D
3,810 lin.ft. 17-ft. sewer in earth	$185.00	$215.00	$219.00	$200.00
6,250 lin.ft. 17-ft. sewer in rock	185.00	190.00	219.00	230.00
1,180 lin.ft. 8 ft. 6 in. sewer	55.00	120.00	50.00	60.00
3 offset manholes	200.00	50.00	200.00	500.00
500 lin.ft. standard manholes	16.00	20.00	15.00	10.00
600,000 lb. reinf. steel	.04	.05	.03	.05
45,000 lb. iron castings and misc. metals	.08	.08	.08	.20
3,000 cu.yd. rock excavation	7.00	7.00	7.00	7.00
Totals	$2,083,300	$2,344,968	$2,397,390	$2,446,200

CONSTRUCTION NEWS

Some of the Week's Large Projects

For further details turn to the appropriate sections in this issue

Location	Project	Cost	Status
Waterworks			
Pittsfield (Mass.)	Reservoir, etc.	$1,500,000	Proposed
Sewers			
New York	Sewage disposal plant	6,680,000	Proposed
Bridges			
Louisiana	Bridges	1,050,578	Contracts
Excav. and Dredging			
Boston	Fill	7,000,000	Proposed
Streets and Roads			
Louisiana	State roads	3,120,996	Contracts
Virginia	State roads	1,050,578	Bids asked
Grade Crossings			
Hamilton (Ont.)	Grade crossing	2,500,000	Proposed
Airport			
Secaucus (N. J.)	Airport	10,000,000	Proposed
Power and Lighting			
New York	Street lighting, etc.	5,520,100	Day labor and separate contracts
New York	Street lighting, etc.	13,650,000	Day labor and separate contracts
Ontario	Transmission lines	4,380,000	Day labor
Sports and Parks			
Jersey City	Stadium	1,500,000	Proposed
Unclassified			
Saratoga Springs	Spa, pavilions, etc.	1,000,000	Proposed
Factories and Mills			
Pekin (Ill.)	Com. sugar plant	1,000,000	Bids asked
Cleveland	Steel mill	1,800,000	Contract
Power Plants			
Bingham (Me.)	Hydro electric project	1,000,000	Proposed
Duluth	Steam heating plant	1,250,000	Bids asked
New York	Generating equipment	6,329,000	Separate contracts and day labor
Schenectady	Power generating development	4,000,000	Proposed
Virginia	Steam power plant	1,000,000	Proposed
Warehouses			
Pittsburgh	Warehouse	4,000,000	Proposed
Buildings			
New York	Church	1,000,000	Proposed
Chicago	Club	1,600,000	Contract
Chicago	Club	1,500,000	Contract
New York	Club	1,800,000	Contract
New York	Club	2,000,000	Proposed
New York	Y. M. C. A.	1,000,000	Proposed
New York	Y. M. C. A.	1,000,000	Proposed
New York	Hospital	1,500,000	Proposed
New York	Hospital	1,000,000	Proposed
New York	Hospital	1,000,000	Proposed
New York	Office	1,000,000	Proposed
San Francisco	American Legion memorial	2,500,000	Bids asked
New Orleans	Markets	1,000,000	Proposed
Boston	Office	1,000,000	Proposed
New York	Art Museum	3,350,000	Bids asked
Toronto (Ont.)	Museum	1,500,000	Proposed
New York	College buildings	1,125,000	Proposed
Washington	Theatre	1,000,000	Bids asked
Perth Amboy	Theatre	1,000,000	Bids asked
Albany (N. Y.)	Theatre, etc.	2,000,000	Proposed

WATERWORKS

PROPOSED WORK

Mass., Pittsfield—City, Water Comn., R. H. Gamwell, chn., reservoir. $1,500,000. Engineer not selected.

Mo., Clarkton—City Clerk rejected bids Dec. 16, tank and tower, and pipe laying. Noted Dec. 11.

N. Y., Goshen—Village, bids about Mar. 1, water supply. $300,000. H. B. Cleveland, 225 Bway., New York, engr. Noted Dec. 25.

Okla., Pawnee—Preliminary plans Diesel engine at City Water Plant. $25,000. J. A. McDaniels, Pawnee, engr.

Pa., Pittsburgh—Reservoir in Lincoln Ave. Dist. $400,000. C. M. Reppert, City-County Bldg., engr.

Pa., Washington — Citizens Water Co. soon takes bids water softening plant. $48,000.

BIDS ASKED

Ky., Cloverport—Jan. 26, by O. E. Ferguson, mayor, waterworks, $55,000; adv. E. N.-R. Jan. 15.

Mich., Detroit—Jan. 27, by Bd. Water Comrs., 735 Randolph St., G. H. Fenkel, genl. mgr. and ch. engr., chemical building for filtration plant; adv. E. N.-R. Jan. 15.

N. Y., Long Island City—Jan. 20, by J. J. Dietz, comr. Water Supply, Gas & Electricity, Municipal Bldg., New York, mains in 19th and 21st Aves., 82nd, 89th, and 91st Sts.

Wash., Aberdeen — City Council bids about Feb. 5, replacing 4 mi. 28 in. pipe line of Wishkah domestic water system. S. C. Watkins, supt. water. Noted Nov. 20.

CONTRACTS AWARDED

Md., Baltimore—Bd. Awards, brick, concrete automatic pumping station at Pikesville, to DeCou & Chidlaw, 857 North Eutaw St., $6,949. Noted Dec. 25, under "Pikesville."

Ore., Portland—Laying mains across Ross Island Bridge and connecting same to mains in each side, to NePage McKenny Co., 27 North Park St., $163,577.

Pa., Greensburg—Westmoreland Water Co., South Greensburg, 1 story brick building over clear water well, 2 story brick building over mixing chamber building, to J. E. Snyder, 1st Natl. Bank Bldg. Noted Dec. 23.

Ont., Chatham—City will construct 1.5 mi. mains, mostly 6 in. in Grand Ave., King St. W., Park, 3rd and Selkirk Sts., day labor. $23,870. T. M. S. Kingston, City Hall, engr. Noted Dec. 18.

Ont., Niagara Falls — City, 10 rapid filter units, to Roberts Filter Co., 11 King St., Toronto, $91,429; switching equipment, to Canadian Westinghouse Co., 286 Sanford Ave. N., Hamilton, $37,975; installing switchboard equipment, to G. Nable, 1599 Falls Ave., $9,708. Grand total $139,112.

Ont., Ottawa—Secretary Bd. Control, superstructure for filtration plant on Lemieux Island, to Ross-Meagher Ltd., Laurentian Bldg., $286,500. Total est. $1,815,000. Noted Dec. 4.

SEWERS

PROPOSED WORK

N. J., Union City—Bd. City Council, sewage disposal plant. Project in abeyance. Noted Nov. 20.

Wash., Seattle—Bd. City Council soon takes bids Charleston Street Intercepting Sewer Unit, incl. 20,000 ft. 8- to 24-in. triple strength vitr. clay pipe, 2 pumping stations. $189,860. R. H. Thomson, city engr. Noted Sept. 18.

Ont., Fort William—City 8 in. and up vitr. tile sewers, disposal plant in eastern portion city. $949,000. C. B. Symmes, city engr.

BIDS ASKED

N. Y., Long Island—Jan. 19, by G. U. Harvey, pres. Queens Boro, Queens Subway Bldg., sewers in Winchester Blvd., 82nd and 119th Rd., Hillside, 94th, Braddock, Jamaica, 90th Aves., 85th, 148th, 183rd and 197th Sts.

N. Y., New York—Sanitation Comn., Municipal Bldg., bids about Feb. 15, sewage disposal plant, incl. 2 story, 50 x 76 ft. administration building, 1 story, 145 x 345 ft. pump and blower house, 1 story, 40 x 94 ft. heating plant, four 1 story, 21 x 34 ft. pumping stations 2 story, 123 x 805 ft. pumping station, 1 story, 68 x 205 ft. sludge storage building, on Wards Island. $6,680,000. Fuller & McClintock, 170 Bway., engrs. Sloan & Robertson, 420 Lexington Ave., archts. Noted Oct. 9.

CONTRACTS AWARDED

Calif., Los Angeles — City Comn., sanitary sewers and house connections in Oxnard St. and Van Nuys Blvd. Sewer Dist., to Culjak & Zelko, 1358 South Bonnie Beach Pl., $209,530.

Ill., Peoria Heights (br. Peoria)—Bd. Local Impvts., A. E. Davidson, pres., 17 mi. 8- to 15-in. tile sanitary sewers emptying 3 places in interceptor sewer of Peoria Sanitary Dist., to J. Brogan & Sons, Green Bay, Wis., $110,646. Est. $146,000.

Kan., Wichita—C. C. Ellis, city clk., to Swortz, McDougall & Lancaster, Peoria, Ill., 6,200 ft. 60 in. rein.-con. vitr. clay lined sewer, at $14.02 per ft., to W. B. Carter, 7 North Rockford St., Tulsa, Okla., 11,270 ft. 36 in. No. 1 vitr. clay pipe at $7.40, 1,100 ft. 36 in. rein-con. pipe $4.50, 25 manholes at $75 each. Total est. $220,556. Noted Nov. 20.

N. Y., Long Island City—G. U. Harvey, pres. Queens Boro, Queens Subway Bldg., to L. Pialo, 199 East Ave., sewers in 30th Ave. $395; to Doric Holding Co., 734 Vernon Ave., 43rd Ave. $6,344; to M. Fornaro, 1730 70th St., Brooklyn, 54th Ave. $4,044, Farmers Blvd. $7,991; to Matarazzo & Yondola, 1163 61st St., Brooklyn, Glenmore Ave., $1,014, 184th Pl. $3,872; to Catapano & Ambrosio, 8211 Bay Parkway Brooklyn, Hempstead Ave. $4,362, Springfield Blvd. $6,032, Ascan Ave. $23,298; to A. Capasso, 65 Liberty Ave., Brooklyn, 175th St., $7,760. Grand total $65,112. Noted Dec. 18.

N. Y., New York—J. Miller, pres. Manhattan Boro, Municipal Bldg., sewer in 11th Ave., to T. A. Riley, 87th St., Jackson Heights, $11,004. Noted Dec. 18.

Ont., Sault Ste. Marie—City, 8 in. and up vitr. tile and concrete sewer in North St. and storm sewers in several streets, mostly day labor. $60,000. A. H. Russell, city engr.

BRIDGES

PROPOSED WORK

Mass., Boston — City, Dpt. P. Wks., preliminary plans rein.-con., steel bridge over New York, New Haven & Hartford R.R., on Morton St., Dorchester. $175,000. J. F. Carty, City Hall Annex, engr.

Mo., St. Louis—Bd. P. Serv., City Hall, and Missouri, Pacific R.R., E. A. Hadley, ch. engr., Missouri Pacific Bldg., and St. Louis-San Francisco R.R., F. G. Jonah, ch. engr., St. Louis, indefinitely postponed rein.-con. viaduct to carry Hampton Ave. over railroad tracks and River Des Peres. $450,000. Noted Jan. 31, 1929.

BIDS ASKED

Ill., Chicago—Feb. 5, by J. J. Sullivan, clk. Sanitary Dist. of Chicago, 910 South Michigan Ave., superstructure South Harlem Ave. Bascule Bridge, Contr. 2, between lines of West 49th and West 51st Sts.; adv. E. N.-R. Jan. 15.

See proposal advertising on page 94

Constr. News page 19

LEADITE

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Tested and used for over 30 years.
Saves at least 75%.

THE LEADITE COMPANY
Land Title Building - - Philadelphia, Pa.

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Bridges (Continued)

Ill., Chicago — Feb. 12, by L. M. Thomas, secy. Bd. Comrs. Lincoln Park and M. E. Connelly, secy. South Park Comrs., and H. E. Young, consult. engr. at office Chicago Plan Comn., 208 West Washington St., Outer Drive Bridge over main branch Chicago River; adv. E. N.-R. Jan. 15.

Indiana—Jan. 27, by State Hy. Comn., Indianapolis, 30 ft. rein.-con. arch bridge, 24 ft. roadway over Little Duck Creek, Franklin Co.—36 ft. rein.-con arch bridge, 24 ft. roadway over Wilson Creek, Fayette Co.—50 ft. rein.-con. arch bridge, 24 ft. roadway over Butlers Run Creek, Franklin Co.—two 150 ft. span steel truss bridge, 22 ft. roadway over Sand Creek, Jennings Co.— 28 ft. rein-con. girder bridge, 24 ft. roadway over Carl Williams Ditch 32 ft. rein.-con. girder bridge, 24 ft. roadway over Louis Ditch 36 ft. rein.-con. arch bridge, 24 ft. roadway over Wolf Creek 84 ft. steel truss bridge, 22 ft. roadway over Bear Creek, all Jay Co.—60 ft. rein.con. arch bridge, 46 ft. roadway 65 ft. rein.con. arch bridge, 46 ft. roadway over Little Calumet River, both Porter Co.—45 ft. rein.con. arch bridge, 24 ft. roadway over Findlay Creek, Boone Co.—60 ft. rein.con. arch bridge, under fill over Kokomo Creek, Howard Co.— two 40 ft. span rein.con. girder bridge, 24 ft. roadway over Pleasant Run Creek 28 ft. rein.-con. girder bridge, 24 ft. roadway over Moores Creek, both Johnson Co.—24 ft. rein.-con. arch bridge, under fill, also 0.53 mi. approach grading over Doe Creek, Putnam Co.—three 24 ft. span rein.-con. girder bridge, 24 ft. roadway over Jacks Defeat Creek, Monroe Co.—one 52 ft. 6 in. rein.-con. girder bridge, 36 ft. roadway, on State Rd. 20, Porter Co.—two 28 ft. span rein.-con. girder bridge, 24 ft. roadway over Indian Creek Branch, Green Co.—three 40 ft. span rein.-con. arch bridge over Indian Creek two 20 ft. span rein.-con. slab bridge over Blue Creek Branch, two 40 ft. span rein.-con. girder bridge over Spring Creek, two 20 ft. span rein.-con. bridge over Goose Creek, all with 24 ft. roadway, Lawrence Co.—three 20 ft. span rein.-con. slab bridge over Heck Ditch, two 20 ft. span rein.-con. slab bridge over Prarie Creek, 50 ft. span rein.-con. arch bridge over Birch Creek, all with 24 ft. roadway, Clay Co. J. J. Brown, dir.

Iowa—Jan. 20, by State Hy. Comn., Ames, 40 x 24 ft. I-beam bridge, 4 culverts, near Swea City, Bd. 9, Project B-667, Kossuth Co.—120 x 20 ft. span high truss bridge with four 40 x 20 ft. I-beam approach spans, 80 x 20 ft. span pony truss bridge with two 40 x 20 ft. I-beam approach spans, 25 culverts, extensions, near New Sharon, Rd. 59, Project B-595, Mahaska Co. —80 x 20 ft. span plate girder bridge with two 32 x 20 ft. I-beam approach spans, 1 culvert in Hastings, Rd. 106, Project B-727, Mills Co.—80 x 20 ft. span plate girder bridge with two 40 x 20 ft. I-beam approach spans near West Liberty, Rd. 76, Project B-513, Muscatine Co. — 48 culverts, extensions, Rd. 9, Project B-702, Emmet Co. C. R. Jones, aud.

Ia., Logan—See "Materials."

Missouri—Jan. 24, by State Hy. Dpt.: Jefferson City, bridges in Adair, Bollinger, Carter, Douglas, Dunklin, Lincoln, Moniteau, Ray, Scott, Stoddard and Wayne Counties. T. H. Cutler, ch. engr.

Tennessee—See "Streets and Roads."

Texas—Jan. 19, by C. Gilchrist, engr. State Hy. Comn., Austin, **(F.A.P. means Federal Aid Project)** rein.-con. bridges on Hy. 6, F.A.P. 71-A incl. 111,306 lb. reinforcing, 623 lin.ft., type D concrete rail, Waller Co. $25,000—rein.con. bridges, Hy. 5, F.A.P. 533-A, 144,305 lb. reinforcing, 747 lin.ft., type D concrete rail, Childress Co. $25,000—200 ft. bridge of 20 slab spans, 2 abutments, grading, drainage structures on 2 approaches, Hy. 74, near Lampassas, Burnet Co., incl. 59,035 lb. reinforcing, 413 lin.ft. (special) concrete rail. $25,000.

Texas—Jan. 19, by G. Gilchrist, state hy. engr., Austin, steel, concrete, timber pile trestle main bridge and 4 relief bridges over Navasota River and Valley, Brazos and Madison Counties, $100,000; 3 concrete, steel bridges over San Miguel, Lagunaville and Live Oak Creeks, on Hy. 97, State Aid Project 628D, Atascosa Co., $230,000—rein.-con., timber pile bridges on Hy. 96, State Aid Project 956-A, Nueces Co., $25,000. Noted Jan. 1 and 8.

Texas—Jan. 20, by G. Gilchrist, state hy. engr., Austin, 2 concrete girder bridges (standard design), one 10 span 285 ft. long, other 6 span 171 ft. long, on Hy. 99, State Aid Project 903-I, Upton Co. $30,000.

Tex., Waxahachie—Jan. 19, by G. G. Gilchrist, state hy. engr., Austin, 30 span, 1,661 ft. steel, concrete viaduct, approaches over Missouri, Kansas & Texas R.R. and Trinity and Brazos Valley R.R., on Hy. 6. $120,000. Noted Jan. 8.

CONTRACTS AWARDED

Colo., Pueblo—Atchison, Topeka & Santa Fe R.R. Co., W. W. Kelly, ch. engr. (Western Lines) **Amarillo, Tex.**, five 115 ft. span steel girder bridge over Fountain River, 2 concrete abutments and 4 concrete piers, to Pueblo Bridge & Constr. Co., 410 West 7th St.; masonry and steel work will be done by owner. Est. $200,000.

Louisiana—State Hy. Comn., Baton Rouge, Boeuf River Bridge, also 6 other bridges, West Carroll and Morehouse Parishes, to J. L. Ham & Co., Minden, $69,378—one 320 ft. swing span, four 250 ft. fixed spans, one 140 ft. fixed span rein.-con. deck girder spans on concrete piles, Red River Parish, to Kansas City Bridge Co., 510 Orear-Leslie Bldg., Kansas City, Mo., $412,278—Red River Bridge, Avoyelles Parish, to Bateman Constr. Co., Nashville, Tenn., $297,567—Bogue Chitto River Bridge, St. Tammany Parish, to S. P. Cook, Fairmont, Ga., $85,270—Tangipahoa River Bridge, Tangipahoa Parish, to E. Pettus, Montgomery, Ala., $11,223—Amite River Bridge, Baton Rouge and Livingston Parishes, to T. H. Brockman, Canal Bank Bldg., New Orleans, $174,802. Grand total $1,050,578.

N. J., Palisades Park — State Hy. Comn., Trenton, bridge on Route 6, Sect. 3, across Route S-1, Bergen Co., to A. Cianciulli, Palisades Park, $47,819. Noted Dec. 25.

New York—A. Goldman, comr. Plant & Structures, Municipal Bldg., New York, Wards Island Anchorage of Triborough Bridge, to Berson Romm, Inc., 11 West 42nd St., New York, $617,955. Noted Dec. 25.

Oklahoma—State Hy. Dpt., Oklahoma City, to J. P. Foty, Burt Bldg., Dallas, Tex., 8 span 140 ft. rein.-con. bridge at Apache, Caddo Co., $24,308 est. $30,000—to L. B. Bybee, Oklahoma City, 6 span 92 ft. rein.-con. bridge at Calvin, Hughes Co., $16,535 est. $25,000—to Boardman & Co., Maple and Hawk Sts., Oklahoma City, 8 span 126 ft. rein.-con. bridge at Mt. View, Kiowa Co., $29,482 est. $30,000; 9 span 140 ft. rein.-con. bridge at Mt. View, Kiowa Co., $29,461 est. $30,000—to Roberts & Fisher, Norman, 7 span 106 ft. rein.-con. bridge at Meeker, Lincoln Co., $24,689 est. $27,000; 7 span 110 ft. rein.-con. bridge at Guymon, $27,585 est. $30,000; 10 span 106 ft. rein.-con. bridge at Guymon, $36,228 est. $40,000, both Texas Co.—to E. G. Fike & Co., Nebraska Bldg., Tulsa, 7 span rein.-con. bridge at Weber Falls, Muskogee Co., $17,810 est. $25,000—to G. M. Brown, McAlester, 9 span rein.-con. bridge at Ft. Gibson, Muskogee Co., $37,332 est. $45,000—to E. S. Alderman, R. F. D. 4, Oklahoma City, 5 span 80 ft. rein.-con. bridge at Tuola, Rogers Co., $19,488 est. $25,000. Grand total $262,918.

Pennsylvania — State Hy. Dpt., Harrisburg, fabricating, erecting superstructure bridge on existing founds., incl. two 236 ft. and one 406 ft. truss spans, one 53 ft. deck span, 30 ft. roadway, one 5 ft. sidewalk, Armstrong Co., to McClintic-Marshall Co., Oliver Bldg., Pittsburgh, $256,444; double span rein.-con. arch bridge, 7,591 lin.ft. rein.-con. pavement, 18 ft. wide, Indiana Co., to Williamson Constr. Co., Turtle Creek, $108,300. Noted Dec. 4 under "Streets and Roads."

South Carolina—State Hy. Comn., Columbia, to D. M. Rickenbaker, Union, 375 ft. rein.-con. bridge, on Route 92, Union Co., $20,707; rein.-con., structural steel bridge on same route, $34,557. Contr. 2, $11,380; rein.-con. bridge and rein.-con. substructure, 375 ft. and 523 ft., Union Co., $55,241; superstructure 524 ft. bridge, Route 15, Laurens Co., $11,382—to R. G. Kennedy, Batesburg, rein.-con. substructure for same bridge, $30,991—to G. A. Thomason, Greenwood, 477 ft. rein.-con. bridge, Route 247, Greenville and Anderson Counties, $38,866—to Alley Constr. Co., Bristol, Tenn., 228 ft. rein.-con. bridge, Route 183, Oconee Co., $20,934—to Florida Bridge & Constr. Co., Orlando, Fla., 125 ft. rein.-con., structural steel bridge on Route 40, Charleston Co., $5,411—to C. Y. Thomason, Greenwood, 250 ft. bridge, Route 183, Pickens Co., $10,675 — to C. T. Felix, Columbia, 75 ft. and 125 ft. rein.-con. bridges on Route 28, Hampton Co., $12,205—to C. M. Lyle Constr. Co., Gainesville, Ga., 300 ft. rein.-con. bridge Route 18, Abbeville Co., $27,585. Grand total $279,934. Noted Dec. 18.

STREETS AND ROADS

BIDS ASKED

Arkansas—Jan. 21, by State Hy. Comn., Little Rock **(F. A. P. means Federal Aid Project)** fine grading, concrete surfacing 6 mi. Job 11015, Route 70-19, F.A.P. 258-A $140,000—8 mi. Job 11016, Route 70-19, F.A.P. 258-A and D $180,000, both 20 ft. wide, St. Francis Co.—4.5 mi. Job 3121, Route 51-A, F.A.P. 265-A $70,000—9 mi. Job 3117, Route 51-1, F.A.P. 265-B $150,000—and 6 mi. Job 3118, Route 51-1, F.A.P. 365-C Res. $100,000, all Clark Co.—12.168 mi. Job 31166, Route 67-2, F.A.P. 263-A Hampstead Co. $130,000—4 mi. Job 6104, Route 67-11, F.A.P. 211-C and 114-A, $70,000—6 mi. Job 6105, Route 67-11, F.A.P. 133, $100,000, both Lonoke Co., all foregoing 18 ft. wide—grading, drainage structures 5.5 mi. Job 0154, Route 91-1, F.A.P. 225-D Lawrence Co., 26 ft., $30,000. C. S. Christian, hy. engr.

Calif., San Francisco — Jan. 21, by Bd. P. Wks., City Hall, grading, concrete, waterbound macadam paving Montgomery and Alta Sts. et al. To exceed $25,000.

Iowa—Jan. 20, by State Hy. Comn., Ames, grading 4.514 mi. Hardin County Line Rd., Rd. 20, Project F-67, Hamilton Co.—10.663 mi. Hamilton County Line Rd., Rd. 20, Project P-714, Hardin Co.—6.768 mi. New Sharon Rd., Rd. 59, Project P-595, Mahaska Co.—10.599 mi. Mills County Line Rd., Rd. 4, Project P-645, Pottawattamie Co. — 5.508 mi. Ft. Dodge-Barnum Rd., Rd. 5, Project P-676, Webster Co. —gravel surfacing 6.661 mi. Humeston Rd., Rd. 66, Project P-327, Wayne Co.—266,930 lin.ft. guard rail, 718 end anchors, Div. 1, Harrison and Shelby Counties—247,270 lin.ft. guard rail, 1,100 end anchors, Div. 2, Audubon, Cass, Adair and Montgomery Counties—255,600 lin.ft. guard rail, 1,366 end anchors, Div. 3, Adams, Taylor, Page and Fremont Counties—289,640 lin.ft. guard rail, 1,230 end anchors, Div. 4, Mills and Pottawattamie Counties. C. R. Jones, aud.

Maryland—Jan. 20, by State Roads Comn., Baltimore, concrete paving 1.55 mi. Contr. Wi-55-12, Wicomico Co. H. Williar, Jr., engr.

Mississippi—Jan. 22, by State Hy. Comm., Jackson, clearing, bridging, grubbing, grading, culverts, 11.074 mi. Laurel-Hattiesburg Rd., F. A. 70-C, Jones Co., C. M. Williamson, dir.

Missouri—Jan. 24, by State Hy. Dpt., Jefferson City, improving roads in Adair, Atchison, Bollinger, Boone, Camden, Carter, Douglas, Dunklin, Gentry, Howard, Lafayette, Lincoln, Moniteau, Pike, Reynolds, Ray, Saline, Scott, Stoddard, Sullivan, Wayne and Webster Counties. T. H. Cutler, ch. engr.

Neb., Lincoln—Jan. 17, by T. H. Berg, clk., grading, curbing, guttering, sidewalks, sheet asphalt paving 6,310 sq.yd. Dist. 810 (27th St. from Clinton to Merril Sts.). $25,000. D. L. Erickson, city engr.

N. J., Cliffside Park—Bd. Boro Council, Boro Hall, rejected bids Dec. 22, grading, sheet asphalt on concrete paving Riverview Ave. $44,500. McClave & McClave, 600 Gorge Ave., boro engrs. Noted Dec. 18.

O., Columbus—Jan. 27, by W. H. Duffy, dir. P. Serv., grading, curbing, guttering, sewers, water connections, paving 15,900 sq.yd. Garden Rd. from 18th St. to Indianapoa Ave., brick $97,083, asphalt $88,733; 4,700 sq.yd. Calumet St. from Olentangy St. to Weber Rd., brick, $26,073, asphalt $23,109.

Pa., Pittsburgh — Jan. 20, by Bd. Comrs. Allegheny Co., J. A. Armstrong, chn., 519 Smithfield St., Class C rein.-con. paving 471 ft. Center St. West View Boro, 24 ft. $8,900; grading, Class C concrete paving 9,300 ft. Elwyn Rd., McNeilly Ave. to Library Rd., Baldwin Twp., 20 ft. $170,000. E. A. Griffith, 519 Smithfield St., engr.

Tennessee—Jan. 30, by State Dpt. Hys. & P. Wks., Nashville, paving 10.624 mi. Monterey Rd., Hy. 42 Putnam and Cumberland Counties—9.503 mi. Crossville Rd., Hy. 42, Cumberland Co.—grading, drainage structures 8.48 mi. Nashville City Limits-Charlotte Rd., Davidson Co., incl. bridge over 20 ft. span—6.807 mi. Rock Creek-Ducktown Rd., Hy. 74, Polk Co., incl. box type bridge over 20 ft. span, also two bridges over 20 ft. span to be let separately—4.08 mi. Clarksville-St. Bethlehem Rd., Hy. 13, Montgomery Co., incl. concrete, steel bridge over Red River—5.44 mi. Morristown-Jefferson Co. Line Rd., Hy. 32, Hamblen Co.—4.86 mi. Hy. 35, incl. 3 concrete bridges—3.72 mi. Sevierville Rd., Hy. 35, Sevier Co., incl. 3 concrete bridges—6.096 mi. Watertown-Lebanon Rd., Hy. 26, Wilson Co.—5.908 mi. Carroll Co. line Rd., Hy. 22, Henderson Co., incl. 4 bridges—grading, drainage structures, paving 7.326 mi. Lawrenceburg Rd., Hy. 6, Lawrence Co. R. H. Parker, hy. engr.

Texas—Jan. 19, by G. Gilchrist, state hy. engr., Austin **S.P. means State Project and F.A.P. Federal Aid Project)**, triple bithulithic surface treating 17.196 mi. Hy. 23, S.P. 768-A, Unit 2, Shackelford Co. $50,000—triple bituthulithic on gravel base course surfacing 18.044 mi. Hy. 24, S.P. 696-B, Knox Co. $122,000—concrete paving 7.416 mi. Hy. 58, F.A.P. 442-B, Brazoria Co., $135,000—11.56 mi. Hy. 21, F.A.P. 490-A, Unit 2, Madison Co. $242,000—grading, drainage structures, concrete paving 16.404 mi. Hy. 96, S.P. 056-A, Nueces Co., $425,000, all foregoing 18 ft. wide—grading, drainage structures 8.634 mi. Hy. 15-A, S.P. 946-B, Dallas Co., $25,000.

Texas—Jan. 19, by G. Gilchrist, engr. State Hy. Dpt., Austin **(F.A.P. means Federal Aid Project and S.A.P. State Aid Project)** bituminous surface treatment on crushed stone surfacing 14.433 mi. State Hy. 1, F.A.P. 558-A, B and C, Unit 2, Hudspeth and Culberson Counties $200,000—triple bituminous surface treatment on waterbound macadam surfacing 11.453 mi. State Hy. 28, F.A.P. 536-A, Unit 2, Cottle Co. $115,000—double bituminous treatment on caliche gravel surfacing 15.72 mi. State Hy. 4, S.A.P. 855-B, Unit 2, Jones Co. $125,000—concrete surfacing 4.943 mi. State Hy. 8, F.A.P. 536-C, Food Co., $120,000—rein.-con. surfacing 6.06 mi. State Hy. 4, S.A.P. 855-A, Unit 2, Jones Co. $125,000, all foregoing 18 ft. wide—grading, drainage structures, 5.071 mi. State Hy. 14, F.A.P. 384, Rev. Unit 1, Ellis Co., 26 ft., $45,000.

Texas—Jan. 19, by G. Gilchrist, engr., State Hy. Dpt., Austin, **(F.A.P. means Federal Aid Project and S.A.P., State Aid Project)** rock asphalt surfacing 8.901 mi. State Hy. 4, S.A.P. 718-C, Unit 2, Dimmit Co. $40,000—bituminous macadam on caliche surfacing 4.542 mi. State Hy. 9, F.A.P. 563-B, Unit 2, Coke Co. $50,000—12.127 mi. State Hy. 9, F.A.P. 563-A, Unit 2, Sterling Co. $140,000, all foregoing 18 ft. wide—grading, drainage structures 3.1 mi. State Hy. 36, S.A.P. 268, Unit 1, Brazonia Co. $27,000—9.356 mi. State Hy. 6, F.A.P. 471-A, Unit 1, Waller Co. $58,000—12.532 mi. State Hy. 5, F.A.P. 533-A, Unit 1, Childress Co. $30,000, all foregoing 26 ft. wide.

Texas—Jan. 20, by G. Gilchrist, engr. State Hy. Dpt., Austin, bituminous surface treatment on gravel surfacing 12.764 mi. State Hy. 80, State Aid Project 849-A, Caldwell Co. $160,000—concrete surfacing 12.002 mi. State Hy. 91, State Aid Project 795-A, Grayson Co. $240,000—14.532 mi. State Hy. 19, Federal Aid Project 485-C and D, Houston Co. $340,000, all 18 ft. wide.

Texas—Jan. 20, by G. Gilchrist, state hy. engr., Austin **F.A.P. means Federal Aid Project and S.A.P. State Aid Project)**, rock asphalt on Caliche base course surfacing 9.177 mi. Hy. 131, F.A.P. 553, Unit 2, Kinney Co., $80,000—double bituminous surface treatment on crusher run broken stone base course surfacing 7.851 mi. Hy. 51, S.A.P. 843-B, Hardeman Co. $100,000—concrete paving 11.861 mi. Hy. 32, F.A.P.

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High-early-strength concrete pavement, made with Universal Atlas methods and cement, on Third Street, Gadsden, Ala. Percy Todd, city engineer; Jones, Rast & Griffith, Gadsden, contractors.

High-Early-Strength Concrete open to heavy traffic 48 hours after placing

AT the height of the cotton shipping season, construction work was under way on a new concrete pavement leading past the storage buildings of the Etowah Warehouse Co., Gadsden, Alabama. Each day the pavement was closed to traffic meant a loss to the warehouse company of almost their entire storage revenue on 4,000 bales of cotton.

By ordinary methods of placing concrete, the new pavement would have been closed to traffic for from 14 to 21 days. Thru the use of high-early-strength concrete, made with Universal Atlas methods and cement, the long section in front of the warehouse was placed Thursday and opened to heavy traffic early Saturday morning.

Methods for securing high-early-strength concrete with standard Universal Atlas cements will be sent on request. Just use the coupon.

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Without obligation, please send me booklet "High Early Strength Concrete for Roads, Streets and Bridges". E. N. R. 1-15-31

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Concrete for Permanence

Streets and Roads (Continued)

559-A, Leon Co. $220,000—8.448 mi. Hy. 43, F.A.P. 453-E, Anderson Co. $175,000, all foregoing 18 ft. wide.

Virginia—Jan. 27, by State Hy. Dpt., Richmond, **(R. means Route and P. Project)** grading, clearing, grubbing, drainage structures 0.5 mi. R. 3-C, P. F-18-ARB Gloucester Co.—10 mi. R. 12, P. F-450-A and B Henri Co.—0.3 mi. R. 38, P. F-646-C Essex Co.—7.6 mi. R. 527, P. F-657-E Nansemond Co.—grading, gravel surfacing 0.5 mi. R. 37, P. F-13-C and B-1 King George Co.—2 mi. R. 37, P. F-438-A and B-1, Stafford Co.—grading, concrete surfacing 12 mi. R. 31, P. F-66, and F-173 and F-213 Chesterfield Co.—8 mi. R. 20, P. F-644-D Prince Edwards Co.—grading macadam surfacing 1 mi. R. 18, P. F-472-A-1 Amherst Co.—5.6 mi. R. 32, P. F-525-A Orange Co.—4.5 mi. R. 10, P. F-603-D, E and H Smyth Co.—2 mi. R. 39, P. F-641-F Augusta Co.—6.5 mi. R. 33, P. F-687 A and B1 and 2 Botetourt Co.— 47 ft. bridge, R. 31, P. F-588-B Arlington Co.—57 ft. bridge, R. 306, P. F-656-B Northumberland Co. $1,250,000. H. G. Shirley, ch. engr. Noted Jan. 8.

Ont., Toronto—See "Contracts Awarded."

CONTRACTS AWARDED

California — State Hy. Comn., Sacramento, grading, asphaltic concrete paving 10.9 mi. road in San Luis Obispo Co., to Peninsula Paving Co., Standard Oil Bldg., San Francisco, $268,382; grading, concrete paving 2.8 mi. Santa Barbara Co., to Gist & Bell, Arcadia, $204,700. Noted Dec. 4.

Ga., Lyons—H. S. Jaudon Eng. Co., Elberton, tt office R. M. McCall, mayor, grading, concrete sidewalks, concrete paving 13,000 sq.yd., Copeland-Wey Inc., 610 Red Rock Bldg., Atlanta, $44,028. Awarded in December.

Ind., Warsaw—Kosciusko Co., concrete surfacing 3.19 mi. Oder Arnold Rd., to Gast Constr. Co., Warsaw, $65,490 est. $72,608—4.63 mi. Jesse B. Marion Rd., to Tri-Lake Constr. Co., Columbia City, $75,939 est. $90,892—2.7 mi. Mary E. Day Rd., to Carvey-Tombaugh & Carvey, Macy, $12,750 est. $15,481. Grand total $154,179. Noted Dec. 25.

Louisiana—State Hy. Comn., Baton Rouge, to Barber Bros., Baton Rouge, concrete surfacing 7.4 mi. roads in Evangeline Parish $153,962; 8.1 mi. Lafourche Parish $182,467; 14.9 mi. Arvovelles Parish $292,907—to A. C. Campbell Winnfield, 17 mi. Winn and Jackson Parishes $400,754—to N. V. Duncan, Chicago, Ill., 11 mi. St. Martin and Iberia Parishes $236,053—to Forum-James Co., Dyersburg, Tenn. 11.6 mi. Ouachita Parish $335,700—to Lang Paving Co., Dallas, Tex., 11.1 mi. La Salle Parish $335,581—to Mattin & Murtishaw, Homer, 12.618 mi. Clairborne Parish $265,686—6.8 mi. Jackson Parish $158,440—to Meyer Greenwald Constr. Co., Monroe, 11.6 mi. Vermillion Parish, $236,210—to Noonan Constr. Co., Pensacola, Fla., 3.1 mi. Livingston Parish $76,509—to Nelson Bros., Columbia Mutual Bldg., Memphis, Tenn., surface treatment on 15 mi. St. Helena and Tangapahoa Parishes $77,474—to N. F. Turner, Marshall, Tex., 20 mi. Beauregard Parish $154,950—to R. B. Taylor & Co., 1446 Levering St., Louisville, Ky., 20 mi. Vernon Parish $132,681—to Flenniken Constr. Co., Shreveport, 12 mi. Union Parish $81,613. Grand total $3,120,996. Noted Dec. 18.

Mich., Monroe—Monroe Co., grading, concrete paving 80,000 sq.yd. Carleton-South Rockwood Rd. from Carlton to South Rockwood, 20 ft., to C. L. LaBoiteaux Co., 4926 Lewis St., Toledo, O., $148,289.

N. Y., Long Island City—G. U. Harvey, pres. Queens Boro, Queens Subway Bldg., granite block paving Grand St., to Columbia Contg. Co., 34 Beebe Ave., $78,400. Noted Jan. 8.

N. Y., New York—Dpt. Plant & Structures, Municipal Bldg., paving approaches to Queens Boro Bridge, to Leonard Paving Co., 233 Bway., $123,550.

North Dakota—State Hy. Comn., Bismarck, graveling 11.732 mi. Sheridan Co., to C. Beyers, Hampton, Ia., $12,272—grading 6.008 mi. Wells Co., to W. H. Noel, Jamestown, $10,293—9.578 mi. McHenry Co. to Schultz Bros., Bowbells, $33,695—8.665 mi. Williams Co. to Hall & Booth, Stanley, $24,763—2.431 mi. P. 408-A, and 9.919 mi. P. 408-B, LaMoure and Dickey Counties, to Haas Constr. Co., Minot, $5,453 and $24,084 respectively — bridge in Grand Forks Co., to J. A. Jardine, Fargo, $6,133. Grand total $116,691.

Oklahoma—State Hy. Dpt., Oklahoma City, grading, drainage structures 7.867 mi. roads in Caddo Co., to S. E. Gray, Muskogee, $32,713 est. $40,000—7.754 mi. Hughes Co. and 6.87 mi. Muskogee Co., to Greer Constr. Co., 519½ West Main St., Oklahoma City, $47,213 and $31,308 respectively, est. $55,000 and $35,000 respectively—7.085 mi. Kiowa Co., to T. C. Ottinger, Hinton, $27,669 est. $30,000—4.91 mi. Lincoln Co., to J. Connelly, El Reno, $27,316 est. $30,000—11.21 mi. Muskogee Co., to J. W. Taylor, Konawa, $40,362 est. $50,000—5.1 mi. Pottawatomie Co., to J. Connelly, El Reno, $28,235 est. $30,000—7.059 mi. Rogers Co., to J. E. Smith, Noble, $34,140 est. $40,000. Grand total $268,956.

Okla., Oklahoma City—See "Airports."

Pennsylvania — State Hy. Dpt., Harrisburg, grading, concrete surfacing 6,500 sq.yd. Schuylkill Co., to Graham Constr. Co., Lancaster, $56,132—20,180 sq.yd. Venango Co., to McDermott Constr. Co., Niles, O., $62,972 — 5,990 sq.yd. Chester Co., to Suburban Constr. Co., Ardmore, $31,846—15,774 sq.yd. Allegheny Co., to R. H. Cunningham & Sons, Turtle Creek, $66,480—grading, drainage structures 12.439 mi. Greene Co., to Tri-State Eng. Co., Cumberland, Md., $16,989. Grand total $234,419. Noted Dec. 4.

Pennsylvania—State Hy. Dpt., Harrisburg, improving 21,845 ft. Route 213, 20 ft., Vernon and Union Twps., Crawford Co., to Hanlon & Oakes, Hadley, $245,936.

South Carolina—State Hy. Dpt., Columbia, grading 18.7 mi. Chesterfield Co., to Carroll-Suber Contg. Co., Columbia, $42,132. This corrects report in Dec. 25 issue under "Contracts Awarded."

South Carolina—State Hy. Comn., Columbia, to Simons-Mayrant Co., Peoples Bldg., Charleston, paving 14.2 mi. Route 30, Darlington Co., $283,053; 9.4 mi. Route 57, Marion Co., $154,097; 18.4 mi. Route 9, Dillon and Marlboro Counties, $250,696 — to Coastal Constr. Co., Florence, 15.3 mi. Route 28, Hampton Co., $235,747 — to Atlantic Bitulithic Co., Munsey Bldg., Wash., D. C., 10.2 mi. Routes 9 and 94, Marion and Dillon Counties, $156,968—to Ballinger Paving Co., Greenville, 10.8 mi. Routes 78 and 6, Bamberg Co., $170,269—to Pennell & Harley, Inc., Spartanburg, 19.9 mi. Route 284, Greenville Co., $407,873; 8.7 mi. Route 7, Laurens Co., $121,301; 12.1 mi. Route 64, Colleton Co., $228,947—to MacDougald Constr. Co., 545 Angier Springs Rd., Atlanta, Ga., 1 mi. Route 61, Dorchester Co., $28,280; grading 3.8 mi. Route 38, Marion and Horry Counties, $67,169—to L. Des Cognets Co., Lexington, Ky., paving 15.6 mi. Routes 21 and 78, Orangeburg Co., $208,687—to Reed & Abee, Inc., Asheville, N. C., 3.3 mi. Route 25, Greenville Co., $93,546—to H. E. Wolfe Constr. Co., St. Augustine, Fla., 21.4 mi. Route 3, Orangeburg and Lexington Counties, $288,617 — to Carolina Contg. Co., 1112½ Taylor St., Columbia, 16.6 mi. Routes 30 and 34, Darlington and Lee Counties, $259,052—to Southern Paving Constr. Co., Volunteer Life Bldg., Chattanooga, Tenn., 0.826 mi. U. S. Route 76, Sumter Co., $15,244—to W. F. Bowe, Jr., Augusta, Ga., 15.8 mi. U. S. Route 25, Edgefield Co., $238,148. Grand total $3,207,694. Noted Dec. 18.

Washington—S. J. Humes, dir. Hys. Olympia, clearing, grading, draining 11.7 mi. North Central Hy., from Vantage to Burke, Grant Co., to Goodfellow Bros., Wenatchee, $255,619—concrete paving 7.1 mi. Ocean Beach Hy., Meskill to Beam Rd., Lewis Co., to Puget Sound Bridge & Dredge Co., Central Bldg., Seattle, $135,508—clearing, grading, crushed stone surfacing 2.1 mi. Lake Samish Rd., Whatcom Co., to East Side Constr. Co., Kirkland, $62,711. Grand total $453,838. Noted Dec. 11.

Hawaii—Territory of Hawaii, Honolulu, asphaltic macadam paving 8.982 mi. Federal Aid Project 8-A, Hawaii Co., to Wheeler & Williams Ltd., Hilo, $164,998.

Ont., Toronto—City, to Grant Contg. Co., 47 Wellington St. E., asphaltic concrete paving Willowbank Ave., $4,941—to Asphaltic Concrete Co., Sun Life Bldg., Willowbank Ave., Contr. A, $2,733—to Kilmer & Barber, Harbour Comn. Bldg., asphalt paving Kendal Ave., $9,078, Bridgeman Ave. $3,298, Cherry St. $20,051. Grand total $40,101.

Ont., Toronto—Scarborough Twp., grading 1.25 mi. St. Clair Ave. from Kennedy to Dawes Rds., day labor. $60,000. E. M. Baird, 1683 Kingston Rd., engr.

EXCAVATION, DRAINAGE, IRRIGATION, LEVEES, RIVER AND HARBOR

PROPOSED WORK

Mass., Boston — Commonwealth of Massachusetts, Dpt. P. Wks., Div. Waterways & Pub. Lands, preliminary plans filling South Bay and Roxbury Canal between Albany St. and New York, New Haven & Hartford R.R. Yards. $7,000,000. J. N. Ferguson, 420 State House, engr.

BIDS ASKED

Calif., Turlock—Jan. 26, by S. A. Sorensen, secy. Turlock Irrigation Dist., 652,671 sq.ft. 2 in. concrete canal lining, 473 cu.yd. concrete in canal structures, 660 lin.ft. 30 in. and 330 lin.ft. 36 in. concrete pipe. Schedules 1 to 5. Former bids rejected. Noted Dec. 11.

La., New Orleans—Feb. 6, at office Bd. Levee Comm. of Orleans Levee Dist., 606 Common St., A. L. Shushan, pres., airport retaining wall on Lake Ponchartrain. J. Klorer, ch. engr.; adv. E. N.-R. Jan. 15.

Mississippi—Jan. 20, by State Hy. Comn., Jackson, cutting canal along north side Biloxi-Ocean Springs bridge between Bents 114 and 117, incl. 2, 250 cu.yd. excav. C. R. Williamson, dir.

N. Y., New York—Jan. 16, by M. Cosgrove, comr. Docks, Pier "A", Battery Pl., North River, dredging between Piers 56 and 62, North River, Contr. 2018.

Tex., Corpus Christi—Jan. 20, by Nueces Co. Navigation Dist. Bd., deepening channel between breakwater and shore line at Corpus Christi, in connection with similar work by government between Aransas Pass and breakwater here. $60,000. Address Dist.

CONTRACTS AWARDED

Calif., Placerville—R. W. Browne, secy. El Dorado Irrigation Dist., furnishing 30 in. c.i. thimble, 30 in. butterfly valve, two 5 in. air valves, 1 needle valve, to Pelton Water Wheel Co., 2929 19th St., San Francisco, $3,500; 795 lin.ft. 30 in. single and double riveted ¼ in. plate steel pipe, installed complete, to Western Pipe & Steel Co., 444 Market St., San Francisco, $7,800. Noted Dec. 18.

New Jersey—State Hy. Comn., Trenton, embankment from Pier 88, near Passaic River to Pier 98, south of Lincoln Hy., Sects. 7 and 8, Route 25, connecting link and Sect. 7A (Ramp) on foundations constructed as caissons sunk to rock, Newark, Essex Co., to Guarantee Constr. Co., 17 Battery Pl., New York, $737,829. Noted Dec. 4.

Pa., Phila.—Dpt. Wharves, Docks & Ferries, R. Wiglein, dir., Pier 4, South Wharves, Schedule A, constructing Schuylkill River Bulkhead west side Mingo Creek, to J. E. Brenneman, North American Bldg., $133,513; Schedule B, test piles between Gibson Point and Baltimore & Ohio R.R. Bridge and Schuylkill River, to H. H. Eyre, 1212 North Delaware Ave., $1,430; Schedule D, Sprinkler system Queen Street Pier 38 S., to J. J. McHugh, 1617 Race St., $64,800; Schedule E, emergency repairs to Floating Plant, to Kensington Shop & Dry Docks Co., Palmer and Beach Sts. $17,427. Grand total $217,170. Noted Dec. 25.

FEDERAL GOVERNMENT

PROPOSED WORK

Conn., Danielson — POST OFFICE — Treas. Dpt. at office Sup. Archt., post office.

Ia., Cedar Rapids — POST OFFICE — Treas. Dpt. at office Sup. Archt., sketches rein.-con., brick, stone post office, between 1st and 2nd Aves., 1st St. to Cedar River.

La., Shreveport—AIRDROME—Con. Q.M. preliminary plans combat airdrome, on 23,000 acre tract, also headquarters building, officers quarters, barracks, for 3rd Attack Group.

Massachusetts — DREDGING, etc. — U. S. Eng., Custom House, Boston, dredging, widening Cape Cod Canal Impvts., Sagamore and Bourne.

Mass., Boston—HEATING SYSTEM—U. S. Eng., improving heating system, at Boston Navy Yard.

Mass., New Bedford — DREDGING — U. S. Eng., Providence, R. I., soon takes bids dredging New Bedford harbor. Noted Aug. 28.

Miss., Meridian—FEDERAL—Treas. Dpt. at office Sup. Archt., post office, 21st and 22nd Aves., 9th and 10th Sts. Noted Jan. 9 Daily.

Tex., San Antonio—HANGARS—Con. Q.M., bids after Feb. 1, three 100 x 250 ft. steel hangars, at Duncan Field. Noted Oct. 9.

Wyo., Thermopolis—FEDERAL BUILDING—Treas. Dpt. at office Sup. Archt., sketches federal building.

BIDS AVOIDED

Arkansas—EARTHWORK—Jan. 22, by U. S. Eng., P. O. Box 667, Vicksburg, Miss., 100,000 cu.yd. earthwork on south bank Arkansas River.

Calif., Eureka—DREDGING—Jan. 22, by U. S. Eng., Custom House, San Francisco, 491,700 cu.yd. Humboldt Bay, Humbolt Co.

Calif., Richmond—DREDGING—Feb. 5, by U. S. Eng., Custom House, San Francisco, 523,500 cu.yd. Richmond Harbor, Contra Costa Co. Noted Dec. 11.

D. C., Wash.—IRON SHEETS—Jan. 19, by A. L. Flint, genl. purch. officer Panama Canal, galvanized pure iron sheets, bronze propellers, portable phantom loads, nickel-plated brass inclosure trimmings, copper or brass netting, kedge anchors, fog horns, portable drink mixers, launch lights, marine door locks, etc., Schedule 2622.

D. C., Wash.—STEEL, IRON PIPE, etc.—Jan. 20, by A. L. Flint, genl. purch. officer Panama Canal, steel, iron, pipe, splice bars, chain drives, etc., Schedule 2620.

Florida—DREDGING—Jan. 26, by U. S. Eng., Jacksonville, 137,000 cu.yd. material other than rock and 274,000 cu.yd. rock from turning basin Miami Harbor.

Fla., Tampa—DREDGING—Jan. 22, by U. S. Eng., Jacksonville, 502,000 cu.yd. material other than rock, and 75,000 cu.yd. rock, in Sparkman Channel, Tampa Harbor.

Illinois—LEVEE—Feb. 6, by U. S. Eng., Rock Island, enlarging existing levee, constructing new levee in Bay Island Drainage & Levee Dist. 1; adv. E. N.-R. Jan. 15.

Massachusetts — DREDGING — Feb. 2, by U. S. Eng., Providence, R. I., 1,331,400 cu.yd. in New Bedford and Fairhaven Harbor; adv. E. N.-R. Jan. 15.

Mass., Fall River—DREDGING—Jan. 19, by U. S Eng., Providence, R. I., 1,124,900 cu.yd. in Fall River Harbor, adv. E. N.-R. Jan. 15. Noted Jan. 8.

Mass., Springfield—ELEVATOR—Jan. 23, by Treas. Dpt. at office Sup. Archt., installing complete elevator plant at U. S. Post Office.

Michigan—DREDGING, etc.—Feb. 13, by U. S. Eng., Detroit, dredging, rock excavation Vidal Shoals, St. Mary's River; adv. E. N.-R. Jan. 15.

Missouri—DIKES—Jan. 21, by U. S. Eng., 428 Custom House, St. Louis, 5,000 ft. piling dikes at Cora Island; 4,000 ft. Springhouse Bend; 7,700 lin. ft. Augusta Bend, all in Missouri River; adv. E. N.-R. Jan. 15.

Mo., St. Louis—DREDGE PONTOONS—Jan. 28, by U. S. Eng. Office, 428 Custom House, 22 steel dredge pontoons; adv. E. N.-R. Jan. 15.

Mo., South St. Joseph — CLUMP DIKES — Jan. 20, by U. S. Eng., 707 Postal Telegraph Bldg., Kansas City, 10,490 lin.ft. standard clump dikes and 5,400 lin.ft. standard revetment in Missouri River at Anderson Reach and Kenmoor Bend, 5.2 mi. from here.

New York—ROCK REMOVAL—Jan. 28, by U. S. Eng., Buffalo, 47,000 cu.yd. material, chiefly ledge rock on United States side of St. Lawrence River, between Ogdensburg, N. Y. and Lake Ontario, adv. E.N.-R. Jan. 15.

N. Y., New York—DREDGING—Jan. 30, by U. S. Eng., Army Bldg., 30 Whitehall St., 16.-

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Federal Government (Continued)

745 cu.yd. ledge rock and 7,225 cu.yd. material other than ledge rock, in Harlem River; adv. E. N.-R. Jan. 15. Noted Dec. 11.

South Carolina—REVETMENT—Jan. 27, by U. S. Eng. Office, Charleston, 3,544 tons rip rap shore revetment at Fort Moultrie; adv. E. N.-R. Jan. 15.

Tex., Fort Sam Houston—QUARTERS—Con. Q.M. bids about Jan. 18, 16 sets commissioned officers quarters. Former bids rejected. Noted Nov. 20.

Utah, Salt Lake City—FOUNDATIONS—Jan. 27, by Treas. Dpt. at office Sup. Archt., foundations for extending and remodeling U. S. Post Office and Court House.

Virginia — LOCK GATES, etc. — Feb. 6, by U. S. Eng. Office, Norfolk, furnishing, delivering lock gates and constructing concrete monolith, sills, certain auxiliary work for Guard Lock in Inland Waterway, at Great Bridge; adv. E. N.-R. Jan. 15.

Wis., Appleton—POST OFFICE—Feb. 9, by Treas. Dpt. at office Sup. Archt., U. S. Post Office; adv. E. N.-R. Jan. 15.

Wyo., Fort Warren—QUARTERS—Feb. 10, at office Con. Q.M. Fort Francis E. Warren, 3 double sets non-commissioned officers quarters, 4 company officers quarters and 1 detachment barracks; adv. E. N.-R. Jan. 15. Noted Oct. 30.

CONTRACTS AWARDED

Ala., Mobile—DREDGING—U. S. Eng., 3,000,000 cu.yd. in section Mobile Channel, to National Dredging Co., 233 Bway., New York, at $0.0547 per cu.yd., total $164,100. Noted Dec. 11.

Ill., Belleville — BARRACKS — Con. Q. M., Scott Field 2 story, basement 76 x 95 ft. air corps barracks at Scott Field, to C. W. Noble, La Crosse, Wis., $98,888; 2 story, basement, 37 x 42 ft. non-commissioned officers quarters, to J. A. Moraw & Owens Co., 144 West 47th St., Chicago, $16,248. Noted Nov. 27.

Ia., Knoxville—INFIRMARY—Vet. Bu., 2 story, basement, 148 x 173 ft., rein-con., brick, steel, to Braecker Constr. Co., 752 Builders Exch. Bldg., Minneapolis, Minn., $188,492; Reinforcing Steel and steel forms, to Concrete Eng. Co., 632 Builders Exch. Bldg., Minneapolis, Minn. Noted Nov. 13.

Louisiana—EARTHWORK—U. S. Eng., 2nd Dist., New Orleans, 40,000 cu.yd. earthwork in Normand's Landing, Red River and Bayou Des Glaises Levee & Drainage Dist., to Acme Constr. Co., Inc., Pointe-a-la-Hache, $7,200; 36,000 cu.yd. in Barbin's Landing, to Baton Rouge Constr. Co., 1305 Florida St., Baton Rouge, $9,000. Recommended for award. Noted Dec. 18.

La., Hallbauer—POST OFFICE—Treas. Dpt. at office Sup. Archt., U. S. Post Office, to Bahm, Inc., 844 Rust St., Chicago, Ill., $104,000.

La., New Orleans — EARTHWORK — U. S. Eng., 48,000 cu.yd. earthwork in Bonnet Carre Spillway Side Levees (extension), to Boone & Wester, Inc., Canal Bank Bldg., $19,680. Recommended for award. Noted Jan. 1.

Missouri — REVETMENT — U. S. Eng., St. Louis, 6,000 lin.ft. bank revetment in Missouri River at Bonhomme Bend, Mile 39-43, to Bilhorn, Bowers & Peters, Inc., Railway Exch. Bldg., St. Louis, $98,575. Noted Dec. 4.

Missouri—PILING DIKE—U. S. Eng., St. Louis, 10,000 ft. piling dike in Missouri River at Bonhomme Bend (Mile 39-43), C. W. Hunter Co., 177 South Front St., Memphis, Tenn., $373,475. Noted Nov. 13.

Mo., St. Louis—GENERATING SETS—U. S. Eng., Custom House, to Elliott & Co., Railway Exch. Bldg., one 800 kw. turbo-generator set, 1 reduction gear and 1 steam turbine $38,465, one 100 kw. turbo-generator set complete, 1 reduction gear and steam turbine $7,321, 1,000 hp. D.C. motor $12,768, 1 switchboard and control equipment $3,224, all foregoing for Dredge Fort Chartres. Grand total $61,778. Noted Dec. 18.

N. Y., Iona Island—BUILDINGS—Spec. 6317—P. Wks. office, 3rd Naval Dist. Headquarters, Washington and Christopher Sts., New York, improving buildings at Iona Island, to S. Pasquale Co., 91 Williams St., Jamaica Plain, Mass., $34,518. Noted Dec. 4.

Oregon—NEEDLE VALVES—Spec. 516—Bureau Reclamation, Denver, Colo., three 48 in. internal differential needle valves for Owyhee Dam, Owyhee Project, to Amer. Locomotive Co., Dunkirk, N. Y., $18,831. Noted Nov. 20.

Tenn., Memphis—NURSES HOME, etc.—Vet. Bu., Dec. 23, general contract nurses home and main building additions, roads, at U. S. Veterans Hospital, to A. Blair, 1st Natl. Bank Bldg., Montgomery, Ala., $291,124. Noted Nov. 20.

Wash., Olympia—DREDGING—U. S. Eng., Burke Bldg., Seattle, 232,000 ft., deepening, widening channel in Olympia Harbor, to Puget Sound Bridge & Dredging Co., Central Bldg., Seattle, at $0.148 per cu.yd.

Va., Portsmouth—EXTENSION, etc.—Treas. Dpt. at office Sup. Archt., extending, remodeling U. S. Post Office, to Jones Bros. & Co., Wilson, N. C., $80,940. Noted Nov. 13.

Ont., Cockburn Island—BREAKWATER—Dpt. P. Wks., Ottawa, Ont., breakwater, wharf, to McLartys, Harton & Wilber Ltd., Sault Ste. Marie, $26,237. Noted June 5 under "Ontario."

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TUNNELS AND SUBWAYS

BIDS ASKED

Ont., Kitchener—Jan. 16, by T. T. Irving, ch. engr. (Central Region) Canadian Natl. Rys., Toronto, widening subways under tracks at Park St., incl. concrete abutments, steel spans, excavation, fill, retaining wall, for City and Canadian National Rys. $30,000.

CONTRACTS AWARDED

Calif., San Jose—Engineering Dpt. Southern Pacific R.R. Co., 65 Market St., San Francisco, G. W. Boschke, ch. engr., Park Avenue Subway, to San Jose Paving Co., San Carlos and Dupont Sts.

Ont., London — Canadian Natl. Rys., C. S. Gzowski, ch. engr. constr., Montreal, Que., 2 subways, to W. H. Yeats Constr. Co., Hamilton, $250,000.

Ont., Toronto—City and Canadian Pacific Ry., J. M. R. Fairbairn, ch. engr. system, Montreal, Que., concrete, steel subway under tracks on Lansdowne Ave., to E. P. Muntz Ltd., Temple Bldg. Est. $200,000. Noted Dec. 4.

GRADE CROSSINGS

PROPOSED WORK

N. J., Jersey City—Bd. City Comrs., City Hall, underpass under Veterans Square. $25,000 or more. **Maturity Indefinite.** J. Henderson, city engr.

N. Y., Henrietta—Lehigh Valley R.R. Co., G. T. Hand, ch. engr., 143 Liberty St., New York, reconstructing structure carrying Erie Station Rd. over tracks, Monroe Co. $57,803.

N. Y., Lackawanna—New York Central R.R. Co., F. B. Freeman, ch. engr., 466 Lexington Ave., New York, Pennsylvania R.R. Co., T. J. Skillman, Broad St. Sta., Phila., Pa., and Lehigh Valley R.R. Co., G. T. Hand, ch. engr., 143 Liberty St., New York, 4 span girder structure, 370 ft. long with 2 span concrete approach trestle at each end, total length 2,040 ft., to carry McKinley Parkway extension over railroad tracks. $352,026.

Ont., Hamilton—Toronto, Hamilton & Buffalo Ry. Co., Hamilton, R. L. Latham, ch. engr., James and Hunter Sts., soon takes bids grade crossings, incl. concrete, steel subways under tracks at Ferguson Ave., James, John, McNab, Walnut, Wentworth and Young Sts. $2,500,000.

BIDS ASKED

Calif., Oakland — Engineering Department Southern Pacific R.R. Co., 65 Market St., San Francisco, G. W. Boschke, ch. engr., taking bids 167 ft. rein.-con. subway, barrel shape, 14 ft. vertical clearance, 23 ft. roadway, 6 ft. walk, at 7th St. $205,000. City pays half of cost. Noted Jan. 1.

N. Y., Yorktown—Jan. 28, by Westchester Co. Park Comn., J. Downer, ch. engr., 72 West Pondfield Rd., Bronxville, overcrossing at Crompond Rd., Bronx Parkway Extension; adv. E. N.-R. Jan. 15.

CONTRACTS AWARDED

New York—Delaware, Lackawanna & Western Ry., G. J. Ray, ch. engr., Hoboken, N. J., eliminating grade crossings on Painted Post-Campbell State Hy., in Erwin, and the Erie R.R. Crossing in villages of Painted Post and Riverside, Steuben Co., to E. P. Muntz, Buffalo, $64,682. Est. $98,811.

N. Y., Briar Cliff Manor—New York Central R.R. Co., F. B. Freeman, ch. engr., 466 Lexington Ave., New York, eliminating Buckouts Crossing 1 mi. south of here, to Walsh Constr. Co., Herald Bldg., Syracuse, $124,309. Est. $168,963.

N. Y., Conesus—Erie R.R. Co., G. S. Fanning, ch. engr., 50 Church St., New York, reconstructing hy. bridge carrying Kuders Corners-Springwater town line county hy. over tracks, to Hecker-Moon Co., 8901 Union St., Cleveland, O., $41,585. Est. $67,482. Noted May 22.

DAMS

PROPOSED WORK

Calif., San Jose—See "Waterworks."

CONTRACTS AWARDED

N. H., Bristol—Pub. Serv. Co. of New Hampshire, A. Schiller, vice pres., Manchester, raising dam at Ayres Island. $860,000. Owner builds. Private plans.

PIERS AND WHARVES

PROPOSED WORK

Mass., Edgartown—PIER—O. Norton, South Water St., 75 ft. wood piling pier, 25 ft. wide, Edgartown Harbor. Private plans.

AIRPORTS

PROPOSED WORK

N. J., Secaucus — Curtiss Wright Airports Corp., 27 West 57th St., New York, revised preliminary plans airport, incl. hangars, machine and repair shops, assembly plant, garages, restaurant, and seaplane basin. $10,000,000. Stone & Webster, 120 Bway., New York, superv. engrs. Noted Apr. 3.

CONTRACTS AWARDED

Okla., Oklahoma City—City Comn., M. Peshek, city clk., gravel surfacing 10,000 cu.yd. for municipal airport, to Western Paving Co., Petroleum Bldg., $44,498. Est. $45,500.

Pa., Pittsburgh—Bd. Comrs. Allegheny Co., 519 Smithfield St., excavation and foundation contract for 73 x 114 ft., T shaped administration building, 30 x 197 ft. Auxiliary Building No. 1, 105 x 152 ft. hangar, to R. H. Cunningham, 619 Pennsylvania Ave., $24,945. Noted Dec. 11.

POWER AND LIGHTING

PROPOSED WORK

Ont., Sudbury—Bell Telephone Co. of Canada, E. C. Forster, mgr., extending telephone system, incl. repeater station, apparatus, switchboard facilities. $30,000.

BIDS ASKED

N. Y., New York—See "Contracts Awarded."

Ontario—See "Contracts Awarded."

CONTRACTS AWARDED

New Hampshire — Pub. Serv. Co. of New Hampshire, Manchester, A. R. Schiller, vice pres., electric power transmission line between Portsmouth and Dover, $212,150; also transmission line between Ossipee and Conway, $94,608. Owner builds. Private plans.

New York—New York & Queens Electric Light & Power Co., Bridge Plaza, Long Island City, will convert 47 mi. overhead lines to underground distribution, Jackson Heights and Woodhaven Dists., $7,793,000; also service main extensions, $1,045,000; and general improvements, subways for mains, Long Island City and vicinity, $4,812,000; street lighting $275,000, day labor and separate contracts.

N. Y., Brooklyn—Fire Dpt., J. J. Dorman, comr., Municipal Bldg., fire alarm system Flatbush Impvt., to M. C. Seelig Co., 153 Pierrepont St., $21,222; and to H. Ihle, 581 St. Johns Pl., $8,391. Noted Dec. 18.

N. Y., New York—New York Edison Co., 4 Irving Pl., street lighting improvements, equipment, buildings and equipment at East River Generating Station, etc., day labor and separate contracts. $5,520,100.

N. Y., New York—E. P. Mulrooney, police comr., Police Dpt., 240 Center St., traffic standards on 5th Ave., to Reliance Bronze & Steel Co., Calyer St., Brooklyn, $45,021. Noted Nov. 20.

N. Y., New York—United Electric Light & Power Co., 4 Irving Pl., generating plant equipment, incl. equipment for Hell Gate Station and other plants, separate and general contracts and day labor. $6,329,000.

Ontario—Hydro-Electric Power Comn. of Ontario, 190 University Ave., Toronto, 1,850 mi. rural transmission line, mostly wood pole construction, day labor. $4,380,000. **T. Hogg,** ch. engr.

SPORTS AND PARKS

PROPOSED WORK

Ill., Peoria—Peoria Park Dist., City Hall, preliminary plans improving Dry Run Creek territory from North University St. to McClure Ave., forming 65.5 acre tract park, 1.25 mi. driveway. $500,000. H. Bartholemew & Associates, 317 North 11th St., St. Louis, Mo., engrs.

Mass., Boston — City, Park Dpt., 33 Beacon St., sketches by O'Connell & Shaw, 134 Newbury St., locker and bath house, North End Park. $125,000. Noted Dec. 11.

N. J., Jersey City—International Stadium, C. Ferrer, pres., Plaza Hotel, preliminary plans rein.-con. stadium, State Hy., Bway., Dale and Logan Aves., Marion Sect. $1,500,000.

N. Y., New York—See "Hospitals under Bids Asked."

Tex., Fort Davis—State preliminary plans state hy. loop in Davis Mountains, scenic park on Fowlkes 20,000 acre ranch. $500,000.

BIDS ASKED

N. Y., Brooklyn—Jan. 20, by Park Bd., W. R. Herrick, pres. Park Dpt., Arsenal Bldg., Central Park, New York, improving Irving Square Park, Wilson and Knickerbocker Aves., Weirfield and Halsey Sts.; improving Bensonhurst Park, Cropsey Ave., 21st and Bay Parkway; Sunset Park, 5th Ave. and 41st St.; constructing rip rap foundation for seawall along Shore Rd. extension around Fort Hamilton Parkway to Dyker Beach Plank; iron picket fence in coping at Winthrop Park, Driggs and Nassau Aves., Monitor and Russell Sts.; cement walk at street intersection along Eastern Parkway.

CONTRACTS AWARDED

Mich., Lincoln Park (br. Detroit) — See "Schools."

N. J., Plainfield — Plainfield Country Club, Woodland Ave., 3 squash courts, to Wigton-Abbott Corp., 552 West 23rd St., New York. Est. $25,000.

N. Y., Babylon — Long Island State Bank Park Comn., Administration Headquarters, Belmont State Park, general contract 1 story bath house, to Riverdale Home Builders, 3511 Cambridge Ave., New York. This corrects report in Dec. 11 issue.

HEATING AND VENTILATING

BIDS ASKED

N. Y., New York—Jan. 20, by W. C. Martin, supt. School Buildings, Flatbush Ave. extension and Concord St., Brooklyn, heating, ventilating, plumbing, drainage, electrical work, lighting fixtures, for P. S. 72, Dewey Ave. from Edison to Logan Aves., for Bd. Educ., 500 Park Ave.

UNCLASSIFIED

PROPOSED WORK

Ariz., Kingman—CYANIDE MILL—Glenidick Mines Corp., c/o H. Derrer, mgr., sketches 50 ton cyanide mill on gold mining property.

N. Y., Jamesville — PLUMBING — Onondaga Co. (Syracuse) replacing plumbing at Onondaga Penitentiary. $40,000. J. A. Vedder, Syracuse, archts.

N. Y., Saratoga Springs—SPA, PAVILIONS, etc.—Saratoga Springs Comn. of State of New York, Albany, and State Waters Corp., Saratoga Springs, spa, pavilions, bath houses. $1,000,000. **Maturity after February.**

BIDS ASKED

Mass., Adams—TOWER—Jan. 20, at Room 426, 11 Beacon St., Boston, war memorial beacon on Mt. Greylock, for Massachusetts War Memorial Com., W. H. Eaton, South St., Pittsfield. $100,000. Maginnis & Walsh, Statler Bldg., Boston, archts. Noted Dec. 18.

N. Y., Long Island City—STATION FINISH WORK—Jan. 23, by Bd. Transportation, J. H. Delaney, chn., 250 Hudson St., New York, station finish work on Northern Blvd., 65th St. and Roosevelt Ave. Stations for Rapid Transit Railroad in Queens Boro.

N. Y., Marcy—TUNNEL—Jan. 20, by Dpt. Mental Hygiene, State Office Bldg., Albany, service connections (tunnels) at Utica State Hospital, Marcy, Div., adv. E. N.-R. Jan. 15. Noted Nov. 20.

N. Y., New York—DOCK—Jan. 19, by M. Cosgrove, comr., Docks, Pier "A," foot of Battery Pl., final extension to Battery Landing Platform, North River, Contr. 1992, and depositing rip rap.

N. Y., New York—PUMPING EQUIPMENT, etc.—Jan. 20, by Bd. Transportation, J. H. Delaney, chn., 250 Hudson St., furnishing, installing pumping equipment on Routes 106 and 108, Bronx and Queens Boro, Agreement "GK," also underground rectifier stations and completing rectifier stations on Route 107, Sects. 11, 12 and 13 and Route 108, Sects. 1 2, 3, 4 and 7.

Pa., Phila.—TRACK FASTENINGS—Jan. 19, by C. E. Walsh, purch. agt. Pennsylvania R.R. Co., 15 North 32nd St., track fastenings, Contr. 1—1931; joint bars, Contr. 2—1931.

CONTRACTS AWARDED

N. H., Portsmouth—DOCK—Pub. Serv. Co. of New Hampshire, A. Schiller, vice-pres., Manchester, private dock for new floating power plant "Jacona" (now under construction). $190,000. Owner builds. Private plans.

N. Y., New York—STATION FINISH—Bd. Transportation, J. H. Delaney, chn., 250 Hudson St., station finish work at 155th, 161st, 167th and 170th Sts., to C. Meads & Co., 217 West 14th St., $341,127. Noted Nov. 6.

MATERIALS

BIDS ASKED

LUMBER, PILING, etc.—**Charles City, Ia.**—Jan. 19, at office Auditor Floyd Co., 9 cars bridge lumber, 2 cars piling, 1 car dimension lumber, 4 cars culvert pipe. J. S. Dawson, Charles City, co. engr.

HARDWARE, CULVERT PIPE, etc.—**Logan, Ia.**—Jan. 20, at office Auditor Harrison Co., 5,300 ft. corrugated culvert pipe, various items hardware, gasoline and lubricating oils, labor in erecting high truss bridge over Harrison-Monona Ditch.

JOINT FILLER, etc.—**New York, N. Y.**—Jan. 19, by H. W. Hubbard, acting pres. Manhattan Boro., Municipal Bldg., 600 tons asphaltic joint filler; 4,000 tons inorganic dust, 8,000 cu.yd. ¾ in. binder stone; 25,000 cu.yd. asphalt sand; 25,000 bags portland cement; 100,000 gal. gasoline.

STRUCTURAL STEEL—**Phila., Pa.**—Jan. 23, by C. E. Walsh, purch agt. Pennsylvania R.R., 15 North 32nd St., structural steel. Contra. 3-1931.

CONTRACTS AWARDED

MANHOLE FRAMES, etc.—**Baltimore, Md.**—Bd. Awards, furnishing, delivering manhole frames, covers to Bureau of Water Supply, to Caroline Fdry. Co., 723 South Caroline St., $7,644; furnishing 200,000 lb. pig lead to N. Trotter, 1821 Maryland Ave., $10,760. Noted Dec. 25.

GRANITE BLOCKS — **Boston, Mass.** — City, Dpt. P. Wks., recutting, redressing, splitting 200,000 granite paving blocks, to W. Toon, 33 Howitt Rd., West Roxbury, at $16.25 per 1,000.

LIQUID CHLORINE—**Minneapolis, Minn.**—F. S. Gram, city purch. agt., 10 cars liquid chlorine, to McKesson-Minneapolis Drug Co., 24 North 3rd St., Minneapolis, $3.64 per cwt. Noted Jan. 1.

SEWER PIPE, etc.—**Minneapolis, Minn.**—F. S. Gram, city purch. agt., vitr. clay sewer pipe, to Red Wing Sewer Pipe Co., Red Wing; 150,000 bbl. portland cement, to Landers-Morrison-Christensen Co., 800 Builders Exch., at $2.23 per bbl.; 300 tons sewer castings, to Amer. Brake Shoe & Fdry. Co., 317 37th St. N. E., at $34 per ton for manhole rings and covers, $39 per ton for catchbasins. Noted Jan. 1.

ASPHALTIC CEMENT — **Long Island City, N. Y.**—G. U. Harvey, pres. Queens Boro, Queens Subway Bldg., to Standard Oil Co., 26 Bway., New York, 200,000 gal. gasoline $16,600, 1,000 tons asphalt cement $12,960, 400,000 gal. road oil, $16,080; to Warner Quinlan Co., 2 Park Ave., New York, 400,000 gal. asphaltic cement, $17,680; to Fred Starr Contg. Co., 250 West 57th St., New York, 25,000 tons ashes, $20,469. Grand total $83,789. Noted Dec. 18.

PIPE—**Ottawa, Ont.**—City, 2,400 ft. 84 in. rein.-con. pipe, to H. Haley, Hurdmans Rd., $35,280.

EQUIPMENT

PROPOSED WORK

ROAD EQUIPMENT—**Wisconsin**—Funds appropriated for purchase during 1931 Ashland Co. one ¾ yd. truck; Barron Co. several motor patrols, large truck, snow plow; Bayfield Co. motor patrols; Brown Co. 3 motor graders; Buffalo Co. 2 motor graders, 2 tractors; Burnett Co. equipment; Calumet Co., 3 truck snow plows; Chippewa Co. 1 truck, motor graders; Clark Co. 2 motor graders, 1 gas crane; Columbia Co. elevating graders; Crawford Co. equipment; Dane Co. one 4 ton truck, one 60 ton tractor; Dodge Co. one 4 wheeled drive truck, snow fence; Door Co. equipment; Douglas Co. 1 large caterpillar tractor, 1 elevated grader; Dunn Co. 1 gravel crushing plant, 1 gas shovel, ¾ yd.; Eau Claire Co. equipment; Grant Co. 2 truck plows, 2 motor graders, two 1-way plows; Fond du Lac Co. wheel scrapers, graders, motor graders; Green Co. 2½ ton truck, 3 motor graders; Forest Co. equipment; Green Lake Co. equipment; Iowa Co. 1 tractor and plow, 1 large truck with plow, 1 motor grader, 1 small tractor with fresno; Iron Co. 6 small trucks, patrol maintenance equipment; Jackson Co. 2 motor graders; Jefferson Co. 1 truck snow plow, 2 motor graders; Juneau Co. equipment; Kenosha Co. motor graders; Keawunee Co. three 5 ton trucks, 3 snow plows; La Crosse Co. 2 snow plows, 2 tractors; Lafayette Co. 1 large truck and snow plow; Langlade Co. snow removal equipment; Manitowoc Co. 3 small trucks, 3 motor graders, 2 large trucks; Marathon Co. motor graders; Marinette Co. 1 large truck, 1 truck snow plow; Milwaukee Co. equipment; Monroe Co. equipment; Oconto Co. 1 truck snow plow, 2 tractor plows, 1 motor grader; Oneida Co. 3 trucks, gas storage tank 2 snow plows, 3 motor graders; Outagamie Co. motor graders; Ozaukee Co. 2 trucks, 2 snow plows; Pepin Co. motor graders; Pierce Co. 1 rock crusher, 1 shovel, 1 motor grader, 2 trucks; Portage Co. 2 trucks; Price Co. 6 ton trucks, 1 motor grader, 1 large grader, two ton trucks; Racine Co. tractor, trucks, snow fence, snow plow; Rusk Co. 1 large truck and snow plow; St. Croix Co. caterpillar tractors, trucks, motor graders; Sauk Co. 1 caterpillar tractor, 1 snow plow, 1 large truck with plow, 2 motor graders; Sawyer Co. equipment; Shawano Co. 2 trucks with grader blades, 1 small truck, 1 caterpillar with mower attachment; Taylor Co. equipment; Trempealeau Co. maintenance equipment; Vernon Co. truck and snow plow, 3 tractors, graders, 1 large grader; Vilas Co., 3 motor graders, 1 truck, with snow plow, 1 large trailer; Walworth Co. equipment; Washburn Co. equipment; Waukesha Co. 1 large grader, truck and snow removal equipment; Waupaca Co. equipment; Waushara Co. equipment; Winnebago Co. 1 large snow plow, two 3½ ton trucks; Wood Co. maintenance equipment.

BIDS ASKED

ROAD TOOLS, etc.—**Hartford, Conn.**—Jan. 31, at 12 Washington St., Hartford, road tools and road construction equipment, for State.

BRACKET FIXTURES, etc.—**Chicago, Ill.**—Jan. 19, by M. J. Kennedy, comr. Gas & Electricity, furnishing, delivering to Dpt. Gas & Electricity, Div. A, aluminum bracket fixtures; Div. B, pole type series transformers for 1,000 c.p. lamps; Div. C, manhole type series transformers for 1,000 c.p. lamps, for extension municipal electric street lighting system.

TRUCK CHASSIS—**New York, N. Y.**—Jan. 22, by H. Bruckner, pres. Bronx Boro, Crotona Park, 3rd and Tremont Aves., two 7½ ton motor truck chassis with special bodies; 1 heavy duty transport trailer, 6 wheel type; 60,000 cu.yd. steam cinders.

FOREIGN

Belgium, Antwerp—City and Provincial Government awarded contract vehicular tunnel, 6,000 ft. long between portals having 2 lane roadway 22 ft. wide, patrol footwalk on each side, under the River Schelde, to Pieux Franki, Liege. Est. $15,000,000.

Greece—Siemens & Halske, Berlin, Germany, awarding contracts constructing telephone extensions and line work at Piraeus, and other locations.

Union Socialist Soviet Republics—Soviet Government c/o Amtorg Trading Corp., 261 5th Ave., New York, chain of broadcasting stations in leading cities of Russia. $45,000,000.

Buildings

RESIDENTIAL

BIDS ASKED

N. Y., Long Island City — See "Contracts Awarded."

N. Y., New York—General Realty & Utilities Corp., 285 Madison Ave., bids about March, general contract 15 story, brick, steel, plain found., East End Ave. $500,000. Polhemus & Coffin, 15 East 40th St., archts. Noted Apr. 24.

N. Y., New York—See "Contracts Awarded."

Wash., Seattle—Seattle Business Properties Co., Seattle, bids about Mar. 5, 21 story, basement apartment hotel, 6th and Bell Sts. $800,000. E. W. Morrison, Lloyd Bldg., archt.

N. Y., Rome—Gansevoort Impvt., Inc., C. Midlan, pres., will award contract after Apr. 1, hotel, stores, $400,000. No new bids. Hart & Shape, 247 Park Ave., New York, archts. Noted Oct. 3.

CONTRACTS AWARDED

N. Y., Long Island City—Hyatt Realties, Inc., 191 Joralemon St., Brooklyn, 6 story, 84 x 117 ft., Hyatt Ave. and 53rd Dr., separate contracts, $250,000. B. Driesler, 153 Remsen St., Brooklyn, archt.

N. Y., New York—J. J. A. Building Corp., O. Quinn, pres., 261 Bway., 6 story, 100 x 136 ft. apartment, 234th St. and Vireo Ave., separate contracts. $200,000. J. P. Boyland, 305 East Kingsbridge Rd., archt.

N. Y., New York—Corporation, c/o F. Frey, 487 East 145th St., 6 story, 82 x 85 ft. apartment, 158th St. and Brook Ave., separate contracts. $150,000. Becker & Levy, 349 East 149th St., archts.

N. Y., New York—Elmorton Holding Corp., A. Karmer, pres., 51 Madison Ave., 12 story, 29 West 90th St., to Geekie Naughton, Inc., 420 Lexington Ave. Est. $600,000.

N. Y., New York—Harkay Constr. Corp., J. Kalikon, pres., 30 East 42nd St., apartments, 210th St. and Kossuth Ave., separate contracts. $185,000. I. L. Crausman, 275 East Burnside Ave., archt.

N. Y., New York—One Hundred Seventy-Four Holding Corp., 1910 Arthur Ave., 6 story, 84 x 120 ft. apartment, Popham Ave. and 174th St., separate contracts. $200,000. G. W. Swiller, 4215 3rd Ave., archt.

N. Y., New York—K. G. P. Realty Co., A. Goldberg, pres., 819 Gravesend Ave., Brooklyn, 6 story, 86 x 100 ft. apartment, Eastern Blvd. and Ward Ave., separate contracts. $180,000. L. R. Uffner, 202 West 40th St., archt.

N. Y., New York—Scalzo & Pisciotta, 1912 Arthur Ave., 6 story, basement, 131 x 139 ft. apartment, Pelham Parkway and Barker Ave., separate contracts. $250,000. L. Pisciotta, 1912 Arthur Ave., archt.

Wis., Milwaukee — B. Uthus, archt., 208 North 3rd St., excavation, concrete work for 4 story, basement, 80 x 142 ft. apartment, to Byrne Bros., 3100 Burleigh St., sublet carpentry, to G. P. Peters, 861 55th Court, for A. G. Wolff, 114 Wisconsin Ave. Noted Nov. 13.

Ont., Toronto—Victoria Gardens Ltd., c/o Ottewell & Coon, 1022 Federal Bldg., 4-story, brick, concrete, Queen St. E., day labor, subletting trades. $150,000. R. Card, 142 Chester St., archt.

CLUBS

PROPOSED WORK

N. Y., New York—National Bureau Y. M. C. A., 347 Madison Ave., bids in March or later Negro branch Y. M. C. A., 174-184 135th St. $1,000,000. A. L. Mackenzie, 5 East 57th St., archt. Noted Dec. 11.

N. Y., New York—New York Fraternity Clubs, 22 East 38th St., raising $2,000,000 funds, club, in midtown section.

N. Y., New York—Seaman's Christian Assn. and Y. M. C. A., 420 Lexington Ave., lets contract on revised plans latter part month, seaman's branch, Y. M. C. A., 11th Ave. and 20th St. $1,000,000. No new bids called. Shreve, Lamb & Harmon, 7 East 44th St., archts. Noted Nov. 6.

CONTRACTS AWARDED

Ill., Chicago—Michaelsen & Rognstad, archts., 3256 Franklin Blvd., general contract 10 story, basement, 19 story tower, 118 x 178 ft., steel, brick, stone club and hotel, to Paschen Bros., 33 North La Salle St., for Motorists Assn. of Illinois, 3254 South Michigan Ave. Est. $1,600,000. Noted Dec. 11.

Ill., Chicago — University of Chicago, 122 South Michigan Ave., general contract 9 story, 173 x 187 ft. Indiana stone international club, dormitories, to R. F. Wilson & Co., 1851 Elston Ave. Total est. $1,500,000. Noted May 15.

Mass., Somerville (br. Boston)—Somerville Y. M. C. A., Highland Ave., altering and constructing (3rd Unit) 4 story, basement, brick addition, plain found., to C. S. Patten, 638 Main St., Melrose. Est. $150,000. Noted Dec. 18.

N. Y., New York—Cobham Realty Corp., A. G. Quinn, 283 Madison Ave., 16 story club, to Bing & Bing, 119 West 40th St. Est. $1,800,000. Contractor now letting separate contracts. Noted Mar. 19 Daily.

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HOSPITALS

PROPOSED WORK

Miss., Jackson—Bd. Comrs. State Insane Removal Comn., rejected bids Jan. 2, 12 buildings for State Hospital for Insane, Rankin Co., near here. $750,000. N. W. Overstreet, Jackson, archt. Noted Dec. 11.

N. J., Preakness—Bd. Freeholders Passaic Co., Court House, Paterson, revised plans by F. W. Wentworth, 410 Market St., Paterson, 2 story, basement, brick, steel welfare house detention home, Oldham Rd. $750,000. Noted Dec. 4.

N. J., Somerville—Bd. Trustees Somerset Hospital, C. C. Kenyon, pres., hospital addition. $150,000. **Maturity indefinite.** Architect not selected.

N. Y., Brooklyn—Evangelical Deaconess Hospital, bids in February, general contract hospital, Chauncy St. $175,000. Allmendinger & Schlendorf, 852 Monroe St., archts. Noted Sept. 25.

N. Y., Brooklyn—Hospital of Holy Family, 283 Hicks St., 6 story, 100 x 150 ft., brick, steel, plain found., Dean St. **Maturity after Nov. 1.** Crow, Lewis & Wick, 200 5th Ave., engrs. and archts. Noted Dec. 12, 1929.

N. Y., New York—Beth David Hospital, H. Uris, pres., 271 Madison Ave., hospital. $1,000,000. **Maturity latter part December.** Noted Dec. 5.

N. Y., White Plains — St. Agnes Hospital, North St., soon lets general contract hospital, $900,000. F. J. Murphy, 280 West 246th St., New York, archt. Noted Dec. 18.

BIDS ASKED

Ill., Aurora—Schmidt, Garden & Ericksen, archts., 104 South Michigan Ave., Chicago, bids about Mar. 1, general contract 6 story, red face brick, Bedford stone addition, also power plant, laundry connected to main building by tunnel, Lincoln and Weston Sts., for Copley Hospital Co., G. A. Anderson, pres. $400,000. Noted Oct. 9.

Kan., El Dorado—Jan. 27, by Susan B. Allen Memorial Hospital Assn., L. D. Hadley, secy., 3 story, basement, 43x132 ft., concrete, brick, $150,000. Washburn & Stookey, 222½ South Main St., Ottawa, archts. Noted Nov. 13.

Md., Crownsville (mail Waterbury)—Jan. 20, at office J. E. Sperry, archt., Calvert Bldg., Baltimore, 4 story, 35 x 85 ft., brick, rein.-con. nurses home, for Crownsville State Hospital, $150,000. H. F. Doeleman, Baltimore Trust Bldg., Baltimore, engr.

N. J., Newark—J. H. and W. C. Ely, archts., 605 Broad St., bids about Apr. 1, general contract 5 story, basement, brick, steel, rein.-con. hospital, nurses home, power house, High St., for St. Barnabas Hospital, J. G. Martin, supt., 685 High St. $1,500,000. Noted Nov. 27.

N. J., New Brunswick — Maginnis & Walsh, archts., 100 Boylston St., Boston, Mass., bids about Feb. 15, on revised plans 5 story, basement, brick, steel, rein.-con. hospital addition, plain found., Easton Ave., for St. Peter's General Hospital, Easton Ave. $150,000. Noted Dec. 25.

N. Y., Brooklyn—Swedish Hospital, Rogers Ave., bids about Jan. 20, general contract hospital addition, Bedford Ave. $150,000. Crow, Lewis & Wick, 200 5th Ave., New York, archts. Noted Dec. 18.

N. Y., New York—Beth Israel Hospital, 60 Jefferson St., bids about Mar 15, general contract altering and constructing hospital addition, 60 Jefferson St. $150,000. H. Hurwitz, 41 West 33rd St., archt. Swimming pool abandoned. Noted Nov. 20 under "Sports and Parks."

CONTRACTS AWARDED

N. Y., New York — Memorial Hospital, 2 West 106th St., 3 story (experimental) X-ray laboratory, to Sobray Whitcomb, 105 West 40th St. Est. $150,000. Noted Dec. 25.

N. Y., Staten Island—J. G. W. Greef, comr. Hospitals, Municipal Bldg., New York, general contract 4 groups steel, timber dormitory buildings, to Balaban-Gordon Co., 1457 Bway., New York, $97,670; plumbing, to R. W. Baylor, 9 Sommers Pl., Port Richmond, $19,931; heating, to Dierks Heating Co., 208 East 31st St., $26,782. Grand total $144,383. Noted Dec. 25.

CHURCHES

PROPOSED WORK

Mass., Everett — Church Home Assn., H. Peterson, 79 Buckham St., new sketches, altering and constructing 1 and 2 story, basement, brick church addition. $150,000. Private plans.

N. J., Darlington — Immaculate Conception Seminary, c/o Myers & Shanley, archts., 24 Walnut St., Newark, revised sketches 2 story, basement, brick, steel seminary, plain found., $150,000. Noted Dec. 8.

N. J., Jersey City—First United Presbyterian Church, W. B. Gold, pastor, 30 Tonnelle Ave., 12 story, basement, brick, steel church, apartment, Sip and Tonnelle Aves. $900,000. Project in abeyance. Noted Oct. 23.

N. J., Rutherford—Bd. Trustees Presbyterian Church, East Passaic Ave., 2 story, basement, brick parish house, Ridge Rd. $150,000. **Maturity indefinite.** Architect not selected.

N. J., South River—A. Merchant, archt., 1 Elm Row, New Brunswick, soon lets general contract 1 and 2 story, tower, church, Sunday school and recreation hall, Main and Gordon Sts., for Conklin Methodist Church. $150,000. Noted Jan. 8.

N. Y., Brooklyn—Evangelical Lutheran Church of Good Shepard, 148 74th St., church 74th St. and 4th Ave. $300,000. Project financing. **Maturity after November.** Cherry & Matz, 441 Lexington Ave., New York, archts. Noted Dec. 12, 1929.

N. Y., Brooklyn—Roman Catholic Church of Immaculate Heart of Mary, 119 East 4th St., bids in May, general contract 73 x 169 ft., church, Fort Hamilton Parkway and East 4th St. $300,000. G. H. Streeton, 9 East 47th St., archt. Noted Apr. 10.

N. Y., New York—Madison Avenue Methodist Episcopal Church, W. W. Sockman, pastor, 1 story, basement church, Park Ave. and 60th St. $1,000,000. **Maturity late in April.** Cram & Ferguson, 258 Beylston St., Boston, Mass., archts. Noted Dec. 4.

BIDS ASKED

N. J., Caldwell — Jan. 16, by N. Hulme, archt., 1524 Chestnut St., Phila., Pa., 3 story, basement, 100 x 105 ft. brick, steel Sunday school, fellowship hall, Elizabeth St. and Academy Rd., for First Methodist Episcopal Church, A. E. Armstrong, pastor, 7 Washburn Pl. $150,000. Noted Oct. 15.

Tex., San Antonio—National Shrine of St. Anthony, c/o P. M. Paque, pastor, bids about Mar. 3, Unit 1, 1 story shrine known as "New Alamo" church building replica of Alamo at San Antonio, $300,000, and bids in May, Unit 2, consisting basilica, with two 180 ft. towers, cloisters 5 chapels, $500,000, both north of Alamo Heights. F. B. Gaenslen, Builders Exchange Bldg., archt. Lilly-Drought Co., Smith-Young Tower, engrs.

CONTRACTS AWARDED

Calif., Los Angeles — University Methodist Church, 34th St. and University Ave., rein.-con. church, 24th St., to W. Simpson Constr. Co., Architects Bldg., $150,000.

Mass., Springfield — St. Barnabas Episcopal Church, J. H. Nolan, pastor, 1 story, basement, brick, stone, to W. W. Davis, 97 Bellevue St. Est. $150,000. Noted Dec. 4.

SCHOOLS

PROPOSED WORK

Ind., Richmond—School Comrs., bids in January on revised plans grade school buildings and additions. Hamilton-Fellows & Nedved, 814 Tower Court, Chicago, Ill., archts. Noted Nov. 13.

N. J., Plainfield — J. S. Pigott, archt., 42 Walnut St., Newark, soon lets general contract 2 story, basement, brick, steel school, Liberty St., for St. Mary's Roman Catholic Church, P. A. Haher, pastor, 516 West 6th St. $300,000. Noted Dec. 25.

N. J., Sussex—Bd. Educ., High School, 2 story basement, brick, steel high school, $150,000. **Maturity indefinite.** Architect not selected.

N. J., Teaneck—Bd. Educ., High School, plans by Hacker & Hacker, 201 Main St., Fort Lee, 3 story, basement, brick, steel high school addition. $600,000. Noted Dec. 11.

N. J., Ventnor (br. Atlantic City)—E. G. Perrot, archt., 1211 Arch St., Phila., Pa., soon lets general contract 3 story, basement, 80 x 115 ft. school, 3 story, basement, 40 x 70 ft. convent, Atlantic and Portland Aves., for St. James Roman Catholic Church, G. Moran, pastor, Atlantic Ave. $250,000. Noted Dec. 18.

N. Y., Brooklyn—Berkeley Institute, college and gymnasium, 181 Lincoln Pl. Project in abeyance until fall. $350,000. Ludlow & Peabody, 101 Park Ave., New York, archts. Noted May 1.

N. Y., New York—Bd. Higher Education, 736 Riverside Dr., sketches by Thompson, Holmes & Converse, 101 Park Ave., and C. B. Meyers, assoc. archt., 31 Union Sq., 2½ story, 85 x 223 ft. gymnasium, $1,000,000, and 1 story, 10 x 46 ft. storage, $125,000, at Hunter College, Bedford Park Blvd. and Navy Ave.

Wyo., Green River—Citizens petitioning Green River School Bd. for $300,000 school bond issue school buildings.

BIDS ASKED

Calif., Los Angeles — City of Los Angeles School Dist., taking bids 2 story, 100 x 190 ft., Class A, rein.-con., brick auditorium, Sawtelle Dist. $175,000. A. S. Nibecker, Jr., city school archt.

Calif., Los Angeles—University of California, 405 Hilgard Ave., Westwood, bids about Jan. 15, 3 story, basement, 150 x 200 ft. rein.-con., stone, tile, marble dormitory, Manning St. and Hilgard Ave. $300,000. D. McLellan, 806 Architects Bldg., archt. G. W. Kelham, 315 Montgomery St., San Francisco, supervy. archt.

Ky., Louisville—Jan. 23, by Bd. Educ., 8th and Chestnut Sts., 2 story 200 x 224 ft., incl. gymnasium, rein.-con., brick, tile, stone, Crittenden Dr. and Phillips Lane. $300,000. J. M. Colley, c/o owner, archt. Ronald & Warren, Heyburn Bldg., engrs. Noted Jan. 8.

Md., Baltimore—Jan. 21, by Bd. Awards, 3 story, 83 x 83 ft., brick, hollow tile, granite addition to School 122, incl. classroom, gymnasium, Preston St. and Druid Hill Ave. $150,000. Flourney & Flourney, 334 St. Paul St., archts. H. Massart, 328 North Charles St., engr.

Tex., Ozona — Jan. 22, by Bd. Educ., c/o Secretary, 2 story, brick, stone, rein.-con. school, $150,000. Peters, Strange & Bradshaw, Myrick Bldg., archts. Noted Oct. 9.

Ont., Toronto—University of Toronto, Queen's Park, bids about Jan. 19, 3 story, basement concrete stone botany building, College St. $400,000. Mathers & Haldenby, 96 Bloor St. W. archts.

CONTRACTS AWARDED

Mich., Lincoln Park (br. Detroit)—Bd. Educ., Lincoln Park, 3 story, basement, brick, steel stone school, incl. swimming pool, auditorium, gymnasium, plain found., to W. W. DeLange, 7040 Farmsworth Ave., Detroit. Est. $690,000. Noted July 31.

N. Y., New York—Bd. Educ., 500 Park Ave., general contract P. S. 103, to Royal Rice Co., 139 East 57th St., $577,700. Noted Dec. 4.

Pa., Grove City—W. G. Eckles Co., archts., 3 story, basement, 49x205 ft. men's dormitory, with 34x87 ft. wing, brick, hollow tile, steel, to R. B. McDanel Co., 4th Ave. and 7th St., New Brighton, for Grove City College. Est. $260,000. Noted Dec. 25.

Ont., Toronto—Collegiate Institute Bd. of York Twp., York Memorial Collegiate, masonry contract for, addition to Vaughan Rd. Collegiate, to Davidge Constr. Co., 109 Alcina Ave.; carpentry, to C. H. Smillie & Son, 40 Main St., Weston; plumbing, heating and ventilating, to W. Stobbs, 46 Moore Ave.; steel, to Reed & Brown, Fleet St.; steel stairs and ornamental iron, to McGregor & McIntyre, 1139 Shaw St. Est. $160,000.

THEATRES

PROPOSED WORK

D. C., Wash.—Warner Bros. Theatres, 321 West 44th St., New York, bids after Feb. 2, general contract theatre. $1,000,000. J. Eberson, 370 Lexington Ave., New York, archt. Noted Dec. 25.

N. J., Long Branch — Paramount Publix Theatres, Paramount Bldg., New York, theatre. $150,000.

N. J., Perth Amboy—J. Eberson, archt., 370 Lexington Ave., New York, bids after Jan. 12, on revised plans 2 story, basement, 105 x 260 ft. brick, steel, rein.-con. theatre, stores, Smith and Maple Sts., for Norkin Co., c/o Warner Bros. Pictures, Inc., lessee, 321 West 44th St., New York. $1,000,000. Ruderman & Severend, 370 Lexington Ave., New York, engrs. Noted Oct. 29.

N. J., Plainfield—Paramount Publix Theatres, Paramount Bldg., New York, theatre. To exceed $250,000.

N. Y., Albany — C. H. Buckley, Theatrical Enterprises, Inc., C. H. Buckley, 43 South Pearl St., theatre and convention hall, South Pearl St. $2,000,000.

N. Y., Glens Falls — Paramount Publix Theatres, Paramount Bldg., New York, theatre. To exceed $250,000.

N. Y., Newburgh — Paramount Publix Theatres, Paramount Bldg., New York, theatre. $250,000.

N. Y., New York — Corporation, c/o H. Diamond, 123 William St., plans by H. I. Feldman, 15 West 44th St., theatre, store, office, Moran and White Plains Aves. $200,000.

N. Y., Plattsburg—Paramount Publix Theatres, Paramount Bldg., bids late in February, general contract theatre. $150,000. Rapp & Rapp, Paramount Bldg., New York, archts. Noted Oct. 2.

Pa., Wilkes-Barre — Warner Bros. Pictures, Inc., 321 West 44th St., New York, bids after Jan. 19, theatre. John Eberson, 370 Lexington Ave., New York, archt.

OFFICES

PROPOSED WORK

N. J., Irvington (mail Newark) — United States Realty & Investment Co., 972 Broad St., Newark, 2 story, basement, 80 x 160 ft., brick, steel office, store, 1015-19 Springfield Ave. $150,000. Project in abeyance. Noted Jan. 8.

N. J., Montclair—Corporation, c/o W. Sambur, archt., 16202 Jamaica Ave., Jamaica, N. Y., sketches 6 story, basement, brick, steel, office, Bloomfield Ave. $150,000 or more.

BIDS ASKED

D. C., Wash.—Feb. 6, at office Pub. Buildings and Pub. Parks, Navy Bldg., 5 story, attic, basement, 62 x 228 ft., steel, rein.-con., marble office building for American Red Cross, adv. E. N.-R. Jan. 15. Noted Mar. 6, under "Office."

STORES

BIDS ASKED

N. J., Newark—Owner, c/o E. A. McMurray, archt., 339 Millburn Ave., Millburn, bids about Mar. 15, general contract 2 story, basement, brick, steel store, apartment, 18th and Melrose Aves. $150,000. Noted Dec. 18.

PUBLIC

PROPOSED WORK

La., New Orleans—MARKETS—Commission Council plans by Sam Stone, Jr. & Co., Masonic Temple, new market buildings or repairing present ones. $1,000,000. Noted Nov. 13.

Mass., Boston—OFFICE—Commonwealth of Massachusetts, Dpt. P. Wks., sketches by Adden, Parker, Clinch & Crimp, 177 State St., office building, Summer St. extension or Nashua St. $1,000,000. Noted Nov. 6.

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Public (Continued)

N. Y., White Plains—COUNTY OFFICE—Bd. Supervs, Westchester Co., Court House, preliminary plans by Morris & O'Connor, 101 Park Ave., New York. Contractors to submit qualifications not later than Jan. 23; adv. E. N.-R. Jan. 15.

N. Y., New York — LABORATORY — Dpt. Health, Municipal Bldg., bids in April, biological laboratory, 16th St. $500,000. Sibley & Fetherstone, 205 West 42nd St., archts. Noted Sept. 25.

BIDS ASKED

Calif., San Francisco—AMERICAN LEGION MEMORIAL and OPERA HOUSE— Jan. 20, by San Francisco Memorial Board Trustees, foundation work, 4 story, basement legion building, 6 story, basement opera house, Civic Center, for City and San Francisco Co. Total $2,500,000 each. G. A. Lansburgh, 140 Montgomery St., archt. Noted Sept. 11.

N. Y., New York—ART MUSEUM—Park Bd., W. R. Herrick, pres. Park Dpt., Arsenal Bldg., Central Park, bids about Feb. 1, general contract 2 and 3 story, at Metropolitan Museum of Art, 5th Ave. between 80 to 84th Sts. $3,350,000. J. R. Pope, 542 5th Ave., archt. E. E. Seelye, 101 Park Ave., structural engineer. Tenney & Ohmes, 101 Park Ave., mechanical engrs. Noted Dec. 25.

N. Y., New York—MUSEUM—Feb. 3, by W. R. Herrick, pres. Park Bd., Park Dpt., Arsenal Bldg., Central Park, erecting, completing Northeast Wing known as South Oceanic Wing and connecting with the Roosevelt Memorial Building, at American Museum of Natural History, Manhattan Sq.

Tex., Sugarland—DORMHTORY, etc.—Jan. 23, by Purchasing Div. State Bd. Control, Austin various materials for general and mechanical contracts for dormitory, administration building, power plant, packing plant at Central State Farm Unit, near here. Giesecke & Harris, Norwood Bldg., Austin, and 2nd Natl. Bank Bldg., Houston, archts.

CONTRACTS AWARDED

N. J., Bayonne — LIBRARY — Bd. Trustees Bayonne Free Library, Avenue C, general contract 2 story, basement, 160 x 160 ft. public library addition, to G. Siegler Co., Inc., 24 Journal Sq., $223,750; plumbing, to J. Reid, 41 West 26th St., $5,990; heating and ventilating, to F. P. Farrell, 269 Camden St., Newark, $13,068; electrical work, to Standard Electric & Acetylene Welding Co., 313 Straight St., Paterson, $21,191. Grand total $263,999. Noted Dec. 23.

N. J., Irvington (br. Newark) — FIRE HOUSE—Bd. City Council, 1253 Clinton Ave., general contract 2 story, basement, brick, steel, to T. Gallo, 242 Madison Ave.; plumbing, to R. B. Smith, 62 Ann St., Newark; heating, to G. L. Dennis, 116 Stuyvesant Ave., Newark; electrical work, to Friedman Bros., 41 Rose Terrace, Newark. Est. $150,000. Noted Dec. 18.

BUILDINGS—UNCLASSIFIED

PROPOSED WORK

Md., Baltimore — PUBLISHING PLANT — Baltimore Post & Scripps Howard Publications, 230 Park Ave., New York, rebuilding publishing plant, recently destroyed by fire, or alterations, new equipment at some other location. To exceed $150,000.

Mo., Kansas City—MAUSOLEUM—Rose Hill Cemetery, 79th and Troots Ave., plans by Greenbaun, Hardy & Schumacker, Scarritt Bldg., rein.-con., marble mausoleum. $200,000.

N. J., Peapeck—EXCHANGE—H. B. Brady, archt., 333 North Broad St., Elizabeth, N. J., soon lets general contract altering and constructing 2 story, brick, steel addition, for New Jersey Bell Telephone Co., 540 Broad St., Newark. $150,000.

N. Y., New York—STORAGE, etc.—Calma Realty Co., J. Mayer, pres., 11 West 42nd St., sketches by V. Bark, Jr., 1351 Bway., 7 story storage and office, 117 West 48th St. $150,000.

Ont., Toronto—MUSEUM—Chapman & Oxley, archts., Sterling Tower, soon lets contract 3 story, basement, 60 x 460 ft., with wing, steel, concrete, brick, stone, for Royal Ontario Museum, Bloor St. W. $1,500,000.

CONTRACTS AWARDED

Wash., Tacoma—EXCHANGE—Pacific Telephone & Telegraph Co., I. F. Dix, pres., 1200 3rd St., Seattle, 4 story, basement, 83 x 123 x 140 ft. brick, steel, terra cotta, granite, to Sound Constr. & Eng. Co., Northern Life Tower, Seattle, and C. E. Bonnell & Son, Tacoma. Est. $475,000. Noted Dec. 18.

Buildings

FACTORIES AND MILLS

PROPOSED WORK

Calif., Olive—PRE-COOLING PLANT—Olive Heights Citrus Assn., B. H. Cole, mgr., sketches rein.-con. plant. $75,000. Private plans.

Calif., Stockton—PAPER PLANT—Schmidt Lithograph Co., 2nd and Bryant Sts., San Francisco, sketches paper plant in Boggs Tract. To exceed $150,000.

Ill., Pekin — CORN SUGAR PLANT — Corn Products Refining Co., 17 Battery Pl., New York, bids after Feb. 1, general contract corn sugar plant. To exceed $1,000,000. Noted Jan. 8.

Mass., Acton—NITRATING PLANT—American Smokeless Powder Co., Acton, reconstructing 1 story plant, recently destroyed by fire. $40,000. Architect not selected.

N. J., Union City—PERFUMERY PLANT—Lockwood Greene Engineers, Inc., engrs. and archts., 10 East 42nd St., New York, soon lets general contract 1 story, basement, brick, steel addition, Palisade Ave., for Yardley & Co. Ltd., 108 Palisade Ave. $40,000.

N. Y., Long Island City—FACTORY—General Bronze Corp., M. Daniels, in charge, 34-19 10th Ave., bids after Mar. 15, plant additions and consolidations. Private plans. Noted Nov. 20.

N. Y., New Windsor (mail Newburgh)—GAS PLANT—Central Hudson Gas & Electric Corp., South Rd., Poughkeepsie, gas plant here, and transmission line from Newburgh through New Windsor to service 2 villages. $40,633.

Pa., Phila.—MANUFACTURING PLANT—Barrett & Co., 40 Rector St., New York, soon lets contract 1 story, 50 x 141 ft., 1 story, 48 x 141 ft., 3 story, 58 x 78 ft., 3 story, 57 x 115 ft. and 3 story, 46 x 115 ft., steel, brick, plain founds., 36th St. and Grays Ferry Rd. Private plans.

Tex., Del Rio—OIL REFINERY—Marathon Oil Co., Thompson Bldg., Tulsa, Okla., plant and distribution system improvements, incl. new equipment to plant, new unit, some new short lines for distribution. Private plans.

Tex., Presidio—CREOSOTING PLANT—Atchison, Topeka & Santa Fe R.R. Co., W. W. Kelly, ch. engr. (Western Lines) Amarillo, creosoting plant, incl. high pressure operated rooms for forcing creosote into railroad ties. $100,000.

BIDS ASKED

D. C., Wash.—MANUFACTURING PLANT—O. J. Maigne Co., 356 Pearl St., New York, bids about July 1, 3 story, basement, 2218 Georgia Ave. To exceed $40,000. Dodge & Morrison, 160 Pearl St., New York, archts. Noted Sept. 11.

N. J., Paterson—DYE FINISHING PLANT—Associated Dyeing & Printing Corp., 35 Albina Ave., taking bids 1 story, basement, 100 x 175 ft., brick, steel, rein.-con., Pennsylvania and Kentucky Aves. $40,000. Private plans.

N. J., Paterson—FACTORY—J. S. Royal, c/o Lee & Hewitt, archts., 152 Market St., bids about Feb. 1, general and separate contracts 2 story, basement, 65 x 165 ft., brick, steel, $40,000. Noted Nov. 27.

N. J., Ridgefield—LITHOGRAPH SHOP—See "Contracts Awarded."

N. J., Rutherford—CLOTHING FACTORY—S. Cordo, 23 West Erie Ave., bids probably about Mar. 1, general contract 2 story, basement 50 x 80 ft. addition. $40,000. F. Pirrone, 104 Midland Ave., Garfield, archt. Noted Dec. 3 Daily.

Wis., Barksdale—NITRIC ACID PLANT—See "Contracts Awarded."

CONTRACTS AWARDED

Miss., Greenville—ICE PLANT—Greenville Ice & Coal Co., L. B. Isenberg mgr., remodeling engine room, office, to York Ice Mchy. Corp., 609 Tchoupitoulas St., New Orleans, La. Est. $40,000.

N. J., Ridgefield — LITHOGRAPH SHOP — Lowe Paper Co., River Rd., 2 story, basement brick, steel, by day labor and separate contracts $50,000. F. L. Smith, 21 East 40th St., New York, archt. and engr. Noted Jan. 8.

O., Cleveland—STEEL MILL—Otis Steel Co., 3341 Jennings Rd., steel mill (continuous strip) equipment and installation, Riverside, to United Eng. & Fdry. Co., Farmers Bldg., Pittsburgh, Pa. Est. $1,800,000. Noted Sept. 25.

Wis., Barksdale—NITRIC ACID PLANT, etc. —E. I. duPont de Nemours & Co., duPont Bldg., Wilmington, Del., nitric acid plant and other manufacturing and chemical buildings, day labor and separate contracts. To exceed $40,000. DuPont Eng. Co., duPont Bldg., Wilmington, Del., engrs.

GARAGES

PROPOSED WORK

Conn., Bridgeport—Goodrich-Silvertown, Inc., 386 Fairfield Ave., modern, brick, steel, concrete super tire service plant, Fairfield Ave. $60,000. Private plans.

N. Y., Brooklyn — St. Johns Corp., 1350 Bway., New York, bids in March or later, separate contracts service garage, 281 Albany Ave. $150,000. S. Pelton, 110 West 42nd St., New York, archt. Noted Sept. 25.

N. Y., Elmhurst — Cord Mayer Co., Bway., sketches by R. Tappan, 1134 Atom Pl., Forest Hills, 100 x 200 ft. service garage, Roosevelt Ave. from 88th to 89th Sts. To exceed $90,000.

N. Y., Long Island City—F. C. David, 319 East 54th St., will award contract about May 1, mortuary, garage, 60 2nd Ave. $40,000. L. H. Bailey, 3113 Grand Ave., Astoria, archt. Noted Mar. 13.

BIDS ASKED

N. Y., Glendale—Phil Dietz Coal Co., Ridgewood, bids about Apr. 1, service garage, 62nd St. and 74th Ave. $40,000. H. C. Bruckner, 2424 Myrtle Ave., Brooklyn, archt. Noted May 29.

CONTRACTS AWARDED

Ont., Toronto—O'Keefe Beverages Ltd., 19 Gould St., 3 story, basement, rein.-con., brick garage, to Tomis Contr. Co. Ltd., 32 Phipps St. Est. $150,000.

POWER PLANTS

PROPOSED WORK

Me., Bingham—Central Maine Power Co., Bingham, subsidiary of National Electric Power Co., 57 Williams St., New York, (2nd and 3rd units) hydro-electric project. To exceed $1,000,000. First unit completed.

Minn., Duluth — J. P. Dwyer, genl. mgr. Duluth Steam Corp., bids latter part month, brick, rein.-con. heating plant, building equivalent to 8 stories, incl. four 600 hp. boilers, pipe lines, Lake Ave. and Commerce St. $1,250,000. Sullivan & Orfault, 408 Palladio Bldg., archts. R. D. Thomas, 1200 2nd Ave. S., Minneapolis, engr. Noted Jan. 8.

N. H., Dover—Pub. Serv. Co. of New Hampshire, A. R. Schiller, vice pres., Manchester, brick, steel, concrete sub-station. $165,000. Private plans.

N. Y., Schenectady—General Electric Co., B. L. DeLack, mgr., River Rd., power generating development, incl. large mercury vapor turbine, 3/5 mi. rein.-con. tunnel, between old and new river road. $4,000,000. New York Power & Light Corp., 511 State St., lessee and operator.

Va., Bremo Bluff—Virginia Pub. Serv. Co., subsidiary National Electric Power Co., 57 William St., New York, steam power plant. To exceed $1,000,000.

BIDS ASKED

Ill., Aurora—See "Hospitals."

Kan., Kansas City—Jan. 28, by Bd. Pub. Utilities, C. A. Lowder, secy., general contract 1 and 2-story, basement, 94x130 ft., rein.-con., brick, steel, site Old Quainpaw Water Plant. Burns & McDonnell Eng. Co., 407 Interstate Bldg., Kansas City, Mo., engrs. Noted Dec. 18.

Wash., Seattle—Bd. P. Wks., bids about Jan. 15, automatic switchboard equipment for installation in Lake Union Auxiliary Power Plant and automatic switching equipment, 3 complete units, housed in 14 in. cubicles, subway transformers for North End Substation. $100,000.

Man., Churchill—Jan. 27, by Secretary Dpt. Railways & Canals, Ottawa, buildings to house power plant. $250,000.

CONTRACTS AWARDED

Kan., Kansas City—Bd. Pub. Utilities, C. A. Lowder, secy., structural steel for 1 and 2 story, basement, 84 ft. high, 94 x 130 ft., rein.-con., brick, steel power plant, Quainpaw Water Plant site, to Kansas City Structural Steel Co., 21st and Metropolitan Aves. $69,000. Noted Dec. 18.

Okla., Cushing—City, J. W. Flint, mgr., 1 story, 55x90 ft., rein.-con., brick power plant, day labor. $300,000. Bids about Jan. 15 building materials, and about Feb. 10, power equipment.

Ore., Eugene—Water Bd., major portion new steam plant power house to Hargreaves & Lindsay, Eugene, $24,312. Noted May 8.

SHOPS AND FOUNDRIES

PROPOSED WORK

N. Y., Brooklyn—SHOP, etc.—Dpt. Hospitals, Municipal Bldg., New York, sketches by LeRoy P. Ward, 205 East 42nd St., New York, shop, auto service and repair shops, at Kings County Hospital. $300,000.

BIDS ASKED

N. J., Maplewood—SHOP and GARAGE—R. B. Platt, archt., 600 Bloomfield Ave., bids about Mar. 1, general contract 2 story, basement, brick, steel, incl. retaining walls, concrete drives, Valey St., for Le Roy Schenck, 513 Valey St. $40,000. Noted Oct. 9 Daily.

WAREHOUSES

PROPOSED WORK

Ky., Lexington — American Suppliers, Inc., subsidiary American Tobacco Co., 111 5th Ave., New York, warehouse. $500,000.

N. J., Newark—Berkowitz Bros., Inc., 359 Plane St., revised sketches by S. Cohen, 134 Branford Pl., 3 story, basement, brick, steel warehouse, 423-25 Plane St. $150,000. Noted Dec. 18.

N. Y., Yonkers—McCann Storage Warehouse Co., 1 Mill St., 7 story, rein.-con., School St. $225,000. **Maturity about April.** Lewis & Leonard, 51 East 42nd St., New York, archts. Noted Oct. 2.

Pa., Pittsburgh—Sears, Roebuck & Co., L. B. DeWitt, in charge, Arthington and Homan Sts., Chicago, Ill., plans by Nimons, Carr & Wright, 333 North Michigan Ave., Chicago, Ill., warehouse on 300 x 1,300 ft. site, General Robinson and Alcor Sts. **Maturity indefinite.** To exceed $4,000,000.

BIDS ASKED

R. I., East Providence (br. Providence) — **Artesian Well & Supply Co.**, c/o E. B. Whipple, engr., 87 Weybosset St., Providence, taking bids 1 story, 85 x 100 ft., brick, steel, concrete storage building, plain found., Blanding Ave. $40,000. Noted Jan. 8.

See proposal advertising on page 94

Constr. News page 25

Non-clogging Sewage Pumps
—horizontal and vertical types

MORRIS Non-clogging Sewage Pumps will pass pulp and semi-solids, rags, sticks and even solid blocks without danger of clogging or breaking. The impellers are especially designed to handle the vast assortment of materials carried through sewer lines, and all parts are proportioned with exceptional sturdiness to withstand hard wear.

Handholes at the suction entrance, and horizontally split casings provide ready access to the interior of the pump, and many exclusive features assure maintenance of high initial efficiency, thoroughly dependable service, protection from end thrust, and effective lubrication.

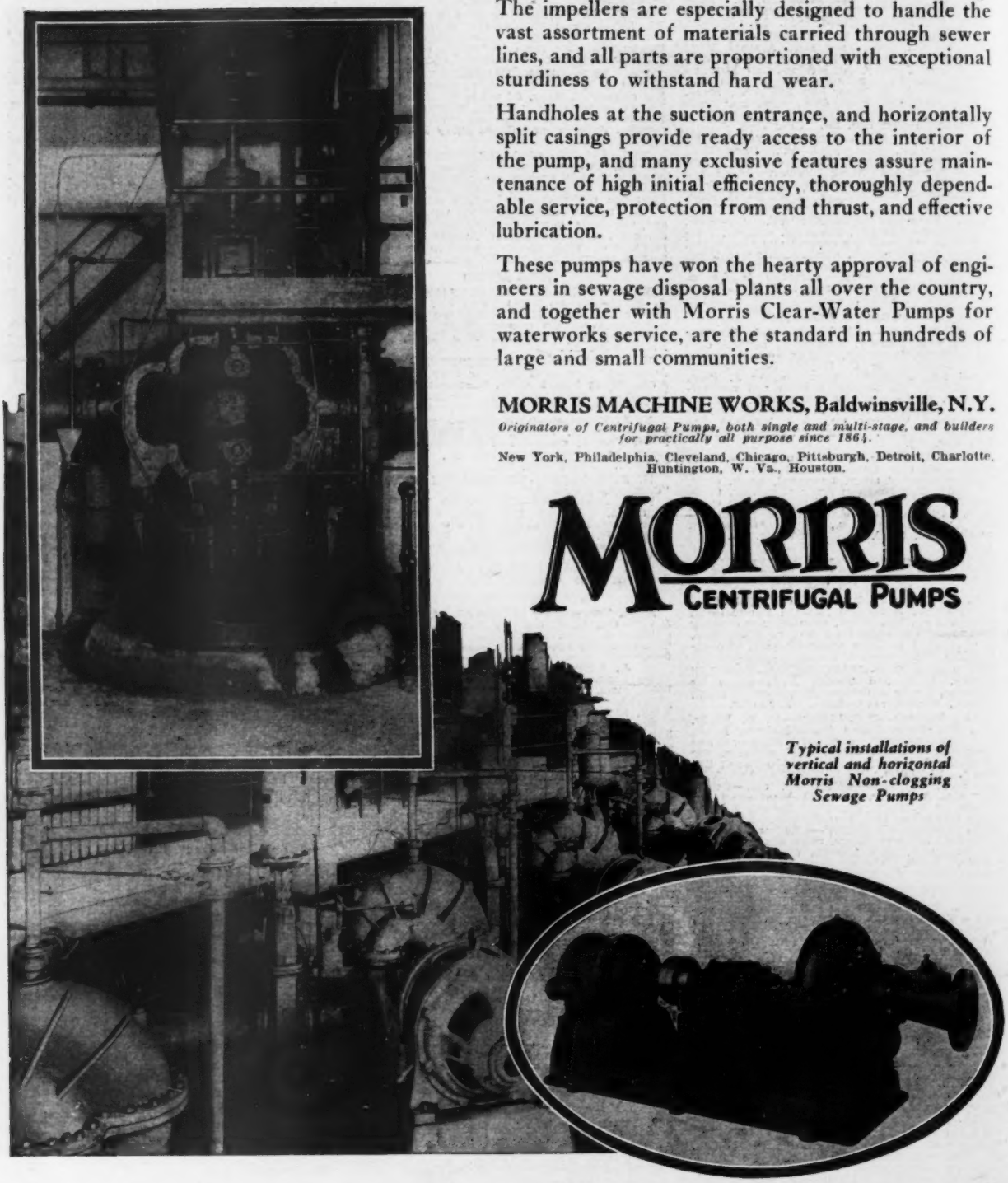
These pumps have won the hearty approval of engineers in sewage disposal plants all over the country, and together with Morris Clear-Water Pumps for waterworks service, are the standard in hundreds of large and small communities.

MORRIS MACHINE WORKS, Baldwinsville, N.Y.

Originators of Centrifugal Pumps, both single and multi-stage, and builders for practically all purpose since 1864.

New York, Philadelphia, Cleveland, Chicago, Pittsburgh, Detroit, Charlotte, Huntington, W. Va., Houston.

MORRIS
CENTRIFUGAL PUMPS



Typical installations of vertical and horizontal Morris Non-clogging Sewage Pumps